CONNECTICUT RIVER FLOOD CONTROL PROJECT

HARTFORD, CONN.

CONNECTICUT RIVER CONNECTICUT

ANALYSIS OF DESIGN
FOR
LOCAL PROTECTION WORKS

ITEM Ht.5 &7b CONTRACT

RIVERFRONT, MORGAN ST. TO STA. 96+73

MAY 1940

CORPS OF ENGINEERS, U. S. ARMY

U.S. ENGINEER OFFICE PROVIDENCE, R.I.

71

CONNECTICUT RIVER FLOOD CONTROL PROJECT

ANALYSIS OF DESIGN

HARTFORD DIKE

FISCAL YEAR 1940 SECTION

RIVERFRONT DIKE

MORGAN STREET TO STATION 96+73

ITEMS HT.5 and HT.7b.

CORPS OF ENGINEERS, UNITED STATES ARMY

UNITED STATES ENGINEER OFFICE PROVIDENCE, RHODE ISLAND

ANALYSIS OF DESIGN
RIVERFRONT DIKE, HARTFORD, CONNECTICUT
MORGAN STREET TO STATION 96+73.
ITEM HT.5 and HT.7b.

INDEX

Page

RIVERFRONT DIKE CONTRACT Ht. 5 and Ht. 7b.

PERTINENT DATA

Location Connecticut River, Hartford, Connecticut

Area protected by the total dike from Memorial Bridge to Wethersfield Avenue, including South Meadows.	1,700 acres
Total length of dike	22,300 ft.
Limits of this contract.	Between Station 0 + 00 at Morgan Street and Station 96 + 73, 900 feet north of Aviation Road.

Elevation (Mean Sea Level)

Elevations for earth dikes are the same as for concrete walls.

Top of wall, Morgan Street, Station 0 + 00 . . .	46.4
Top of wall, Station 5 + 00	44.9
Top of wall, Station 85 + 00	44.4
Top of dike, Station 96 + 73	43.6
Top of riprap	8' below top of dike

Embankment

Maximum height of dike	33 ft.
Total length	5,620 ft.
Total impervious embankment fill	116,000 c.y.
Total pervious embankment fill	391,000 "
Total random fill	20,000 "
Grand total embankment	527,000 "
Total steel sheet piling	281,400 s.f.
Total riprap	21,500 c.y.
Total dumped rock	48,700 "

Total gravel bedding	11,250 c.y.
Total topsoil	23,000 "

<u>Miscellaneous fills</u>

Dredged fill and spoil, Park River	185,000 "
Dredged fill and spoil, Commercial Wharf	100,000 "

<u>Concrete Walls</u>

Type	Cantilever and counterfort
Maximum height of stem	37 feet
Total length of walls	4,150 "

<u>Concrete quantities</u>

Total volume	22,000 c.y.
Concrete walls, total volume	20,500 "
<u>a</u>. Morgan Street to Grove Street 11,700 c.y.	
<u>b</u>. In front of Dutch Point Station 3,900 "	
<u>c</u>. In front of South Meadows Station 4,900 "	
Pumping station conduit and gate structures. . .	860 c.y.
Masseek Street sewer and appurtenant structures	430 "
Miscellaneous structures	210 "
<u>Concrete piling</u>	53,850 l.f.

I. INTRODUCTION

I. INTRODUCTION

A. AUTHORIZATION AND PAST REPORTS. - The flood protection work from Morgan Street south to Station 96 + 73, known as the Riverfront Dike, is a part of the local protection works for the City of Hartford, Connecticut. The original project is included in the Comprehensive Plan of Flood Control for the Connecticut River as described in House Document No. 455, 75th Congress, 2nd session, and is authorized under the Flood Control Act, approved June 28, 1938.

B. NECESSITY FOR THE PROTECTION. - An important area of Hartford consisting of approximately 1700 acres south of Morgan Street, bordered by the Connecticut River and Wethersfield Town line was inundated during the great flood of 1936. Most of this land is low and would without dike protection, be subject to frequent flooding. The dike between a point 900 feet north of Aviation Road and Wethersfield Avenue has been completed. The remaining 9673 feet of the proposed Riverfront Dike and the Park River conduit, which will be constructed under a separate contract, will complete the flood protection for the entire area south of Morgan Street. The northerly half of the area comprising the area directly back of the Riverfront Dike is thickly settled and has numerous business and industrial establishments thereon. The southerly half of the area is mostly undeveloped, except that the Colt Patent Firearms Works is located here. There are also included within the area to be protected several miles of the New York, New Haven and Hartford Railroad Company's main freight line track, the "South Meadows" and the "Dutch Point" stations of the Hartford Electric Light Company. The flood protection work covered in this analysis is the most important part of the local protection works for the City of Hartford.

C. PROVISION FOR PUMPING FACILITIES. - The construction of the protection works for the area just described will prevent the natural surface drainage within the area from reaching the Connecticut River during high river stages. For the purpose of discharging the accumulated surface drainage, including that from local storm run-off from within the protected area and seepage through the dikes or their foundations, a pumping station is necessary. The construction of the pumping station will be provided under a separate contract, except that a portion of the discharge conduit will be included under this project. The discussion of the pumping station design in this analysis is therefore confined to that part which pertains directly to the discharge conduit.

D. CONSULTATION WITH REPRESENTATIVES OF THE CITY. - Before and during the actual design of the protective works, consultations involving basic features were held with officials of the City of Hartford and the Flood Commission of Hartford. The New York, New Haven and Hartford Railroad Company was not directly consulted by this office. The relocation of the existing railroad line behind the dike will be performed under a separate contract and discussions on all matters pertaining to this relocation were carried out between officials of the City and the Railroad Company. Details pertaining to the railroad stop-log structure as well as all pipe details at the South Meadows Electric Station, and Dutch Point Station were decided on in conference with officials of the Hartford Electric Light Company. The Hartford Flood Commission was represented by Mr. Charles Bennett, consulting Engineer and Executive Secretary for the

Commission, and the Hartford Electric Light Company by Mr. T. H. Soren, Vice President and Construction Manager.

The City of Hartford, through its Flood Control Commission, requested additional construction items not originally planned by this office to be included, all of which will be paid for by the City. Paramount among these items were construction of earth dike and concrete flood walls to elevations approximately 5 feet higher than the grade recommended by the Board of Engineers for Rivers and Harbors, additional riprap made necessary by change in alignment, extra fill for the abandoned portion of the Park River at Dutch Point and extra fill for future construction of a commercial wharf at Wawarme Avenue and additional steel sheet piling for cut-off. The project as proposed under this contract will primarily be constructed for Flood Control; however, the selected alignment and the design are such that it can be made an integral part of a future riverfront boulevard, extending from Morgan Street to Wawarme Avenue. The design as finally developed meets with the approval of the Flood Commission of the City of Hartford.

E. SHORT DESCRIPTION OF THE PROTECTION WORKS. - The protection work consists of concrete flood walls and earth dikes. Steel sheet pile cut-off will be provided under both concrete wall and earth dike. Beginning at the south face of the Memorial Bridge abutment, approximately Station 0 + 18, a concrete wall extends to Station 21 + 82, a point south of Grove Street; an earth dike extends from Station 21 + 82 to Station 36 + 00; the Park River Conduit which will be constructed under a separate contract crosses the dike at Station 34 + 84. The protection in front of the Dutch Point Station consists of a concrete wall, part of which is founded on concrete piling, from Station 36 + 00 to Station 42 + 54, followed by an earth dike to Station 80 + 10. The protection works in front of the South Meadows Station also consist of concrete wall, extending from Station 80 + 10 to Station 91 + 95. An earth dike joining the recently completed portion of Clark Dike, extending from Station 91 + 95 to Station 96 + 73, completes the protection works under this project. Two small stop-log structures will be provided in the wall in front of the South Meadows Station. In addition to a ramp constructed for access from Wawarme Avenue to a future commercial wharf, landside service ramps will be provided at the ends of each earth dike section. The total length of concrete wall will be 4,150 feet, and of earth dike 5,620 feet. The average height of the concrete walls will be 25 feet above the existing ground. The earth dike will be constructed of free draining sand dredged from the river and this section will be provided with impervious blanket and riprap. The top width of the dike will be 15 feet. Where future enlargement is contemplated the landside slope will be provided with a 6-inch layer of topsoil, sodded and seeded, otherwise a 12-inch layer of topsoil, sodded and seeded will be provided. For location and general plans see Plates Nos. 1, 4 to 21 inclusive.

II. SELECTION OF ALIGNMENT AND TYPE OF PROTECTION

II. SELECTION OF ALIGNMENT AND TYPE OF PROTECTION

A. OTHER ALIGNMENTS CONSIDERED. - The study of alignment was considered from two different points of view. For dike construction to furnish flood protection to the United States Engineer Department grades as recommended by this office it was assumed that all riverfront developments including the existing railroad line would be left unimpeded. Under this assumption several establishments would, with a safe and economical alignment, be left outside the protection. Several stop-log structures would therefore be necessary for access to these areas. Originally both the South Meadows and the Dutch Point Stations of the Hartford Electric Light Company were planned to be left outside the protection. However, the 1938 flood revealed that the protective measures taken by the Company after the 1936 flood were inadequate, and this office sought and obtained authorization to include both stations under the protection, and to pay for construction of protection work to the grade recommended by the Board of Engineers for Rivers and Harbors. For the dike construction as proposed by the City, the entire riverfront necessary for both dike and boulevard will be acquired and the railroad line will be relocated where necessary; therefore, no other alignment than that selected has been studied.

B. SELECTED ALIGNMENT. - The alignment adopted for the Riverfront Dike is that which was selected by the Flood Commission of the City of Hartford to serve both for flood protection and for a riverfront boulevard. The alignment includes protection of both the South Meadows and Dutch Point Stations of the Hartford Electric Light Company. The project is adapted for enlargement to include the future boulevard and it will afford the maximum of desired protection at a minimum cost. Owing to the close proximity of the work to the river, heavy rock toes and rip-rap will be constructed to prevent any danger from erosion.

C. <u>SELECTION OF TYPE OF PROTECTION</u>. - In selecting the type of protection much consideration was given necessarily to the future boulevard. Except in front of the two electric light stations, where concrete walls are necessary, it can be said, that the type of protection works selected depended chiefly on the boulevard construction and railroad relocation. The stop-log structures are of minor importance. Steel sheet pile cut-off will be used for both earth dike and concrete wall to minimize seepage. A complete cut-off has been effected in the full length of the work and toe drains have been used to intercept possible seepage, where needed.

III. FLOOD HYDRAULICS

III. FLOOD HYDRAULICS

A. DESIGN FLOOD. - The design flood on which the dike grade is based is the maximum predicted flood reduced by the 20 reservoirs of the Comprehensive Plan. The determination of the maximum predicted flood is discussed in Appendix 1 of "The Report of Survey and Comprehensive Plan for the Connecticut River," dated March 20, 1937. It has a peak discharge at Hartford of 318,000 c.f.s., approximately 10 percent greater than the maximum flood of record. (See Criterion 1, Paragraph V A.)

B. FREEBOARD. - The survey report proposed a uniform freeboard of 3 feet for both concrete walls and earth embankment. This was based on consideration of wave fetch and velocity. (See Criteria 1 and 2, Paragraph V A.) The Board of Engineers for Rivers and Harbors recommended that, since the entire reservoir plan might not be effective for some time, the earth section be raised 2 feet. The design has been modified to meet this recommendation.

The City of Hartford has made flood studies and desires greater protection than that which will be offered by the dikes proposed by this office. The grades proposed by Hartford are based on a flood 25 percent greater than the maximum flood of record, or 360,000 c.f.s., and are about 5 feet higher for the Riverfront Dike than those proposed by this office.

The dikes and walls will be constructed to the grades proposed by the City of Hartford which to mean sea level datum are: 46.4 at Station 0+00, Morgan Street; 44.9 at Station 5+00; 44.4 at Station 85+00 and 43.6 at Station 96+73, the end of dike under this contract. The City will pay the extra costs involved.

C. LOCAL CONDITIONS. - Flood stages in the Connecticut River between Hartford and East Hartford will be increased slightly by the confinement caused by dikes at the two locations. The dike grades have been adjusted to meet this situation.

D. PUMPING REQUIREMENTS. - The natural surface drainage and storm run-off from the area inclosed by the dike, and the seepage through the dike, will have to be pumped from the protected area to the river. The pumping station which will take care of this is handled in a separate contract, and the selection of pumping capacity has been treated in the design analysis for that pumping station. (See Criterion 9, Paragraph V A.)

IV. GEOLOGICAL INVESTIGATIONS.

IV. GEOLOGICAL INVESTIGATIONS

A. SITE AND FOUNDATION CONDITIONS.

1. Nature of valley. - The project is located on the right bank of the Connecticut River, which is flowing above and on the westerly side of a broad and deeply buried pre-glacial rock valley. The highest elevation (Elevation-10) of rock is situated at the northerly end, adjacent to Memorial Bridge or Morgan Street, from which point the rock surface dips toward the east and south. At no point is rock available for foundations. The river is entrenched in glacial deposits of sand and varved clays and more recent alluvial deposits of sand and silt. In periods of high water the stream carries a considerable load of sand on its bottom, and upon overflowing its banks deposits fine sand and silt on its flood plain. Although the reach of river concerned in this project is relatively straight the channel crosses from one side to the other. Weathersfield Cove, a remnant Ox-Bow, located about 1 mile south of the southern limit of the project indicates considerable meandering of the channel during the past.

2. Method and extent of explorations. - A large number of borings along the dike alignment were made by the City of Hartford. The records of these explorations have been used to the fullest extent. However, the Providence District has completed other bore holes, mainly for the purpose of checking the accuracy of data obtained by the City of Hartford, and for filling in gaps where information was uncertain. A comparison of the results of both investigations showed close agreement as to the general character of foundation materials. Providence District

investigations by borings, utilizing drive sampling methods, were made (1) to check on the City of Hartford's determinations as to the character and thickness of overburden forming the dike foundations, (2) to investigate the impervious varved clay stratum along the line of sheet pile cut-off, (3) to investigate sediments in the Connecticut River as a potential source of pervious embankment material. Several large diameter borings were also complete for obtaining undisturbed 4-7/8" diameter clay samples. The location and records of exploration are shown on Plates Nos. 22 to 26 inclusive entitled "Subsurface Explorations." The location and records of borrow explorations are shown on Plates Nos. 27 and 28. Transverse geologic sections are shown on Plate No. 29.

3. Site. - Underground conditions are similar throughout much of the extent of the project. Before encroachment of the City of Hartford upon the river bank the river periodically overflowed its banks and deposited on its flood plain a mantle of fine sand and silt. These sediments are now obscured by an overburden of fill which in the old filled-in channel of the Park River attains a maximum thickness of over 40 feet. Beneath the flood plain sediments there occurs a prominent stratum of pervious sands (Classes 2 and 4) which extend to and outcrop in the river bed. Except in the northern one-half mile, adjacent to Memorial Bridge, these sands lie on a thick varved clay or interstratified silt and clay formation, the top of which varies between about Elevation 15 and Elevation 20. A compact mixture of sand, silt, and gravel separates the clay stratum from a deeply buried shale formation.

4. Nature of excavations. - Preparation of the levee foundation will require excavations for the toe trenches and stripping throughout the

foundation area. Excavation for the impervious toe trench will be carried to an average depth of about 5 feet; that for the toe drain to an average depth of 4 feet. Excavations for the footings of the concrete wall sections will be carried to an average depth of 4 feet.

5. Subsurface leakage. - From a point north of the Dutch Point Station to the junction with the completed Clark Dike south of South Meadows Station seepage through underlying pervious strata will be effectively stopped by construction of a steel sheet pile cut-off throughout the entire length of the dike. The remainder of the dike north to Morgan Street will be provided with short steel sheet piling to effect a fairly complete cut-off in this area, but toe drains have been used to intercept possible seepage (See Criteria 5 and 9, Paragraph V A.)

B. BORROW AREAS. - For construction of the earth dikes, two major borrow areas are proposed as shown on Plate No. 27, entitled "Borrow Areas." Area "H" is the source of impervious material for the rolled impervious blanket of the dike. This area consists of glacial till interstratified with silt, classes 11 and 13, with natural water content only slightly above that for optimum compaction. Area "H" has been developed in previous use in embankment construction.

Area "A_3" is the major source of pervious material to be dredged from the Connecticut River bed for use in constructing the major portion of the dikes. River sediment in this area is composed of coarse to medium sand, classes 2 and 4, with some beds of fine gravel. This pervious material forms the present river bottom and overlies a deep bed of varved clay. In the major portion of the dike the pervious sand will be dredged directly from the river into the embankment. Minor quantities will be dredged into stockpiles and later transferred and rolled into the embankment.

Additional pervious sand is available in the river bed in Borrow Areas "A_2" and "A_4". These areas may be required if considerable quantities of river sands are scoured out of Area "A_3" by floods during the construction period.

Table No. 1, entitled "Summary of Materials Available" summarizes materials required and those available and shows major soil characteristics. Compaction characteristics in this table are those expected in the embankment and are based on previous experience with materials from the same or similar borrow areas. Typical grain-size curves for the borrow materials are shown on Plate No. 31.

TABLE NO. I
SUMMARY OF MATERIALS AVAILABLE
RIVERFRONT DIKE, HARTFORD, Ht.5-7b

Soils Laboratory
Estimate No. 1
May 14, 1940

MATERIALS REQUIRED		MATERIALS AVAILABLE					COMPACTION CHARACTERISTICS	
TYPE	QUANTITY, CU.YDS.	SOURCE	QUANTITY: CU.YDS.: EX.MEAS.	CLASS AND TYPE	PERMEABILITY COEFFICIENT k = CM./SEC. x 10^{-4}	ANGLE OF INTERNAL FRICTION, ϕ	OPTIMUM WATER CONTENT, %	COMPACTED DRY WEIGHT, LBS. PER CU. FT.
Impervious	60,000 Fill Meas. 60,000 Excav.Meas.	Borrow Area "H"	300,000	Class 11 in upper layer underlain by Class 13.	0.01 - 0.1	33° - 34°	16 - 22	100 - 105
Pervious	640,000 Fill Meas. 770,000 Excav.Meas.	Borrow Area "A_3"	800,000*	Classes 2 and 4-2 sand to be dredged from river bed and sand bars.	100 - 300	32° - 36°	- - -	101 - 104 As sluiced in place
		Borrow Area "A_4"	400,000*					
		Borrow Area "A_2"	150,000*					

* Quantities obtained as 50% of total estimated volume of sand in river.
Remaining 50% taken as waste.

V. EARTH EMBANKMENT, DESIGN CRITERIA, LABORATORY INVESTIGATIONS AND FOUNDATION PROBLEMS

V. EARTH EMBANKMENT, DESIGN CRITERIA, LABORATORY INVESTIGATIONS AND FOUNDATION PROBLEMS

A. GENERAL DESIGN AND CRITERIA. - The design of the embankment section is similar to that built in North Meadows upstream of Morgan Street and is the standard section as adopted for the Providence District. It will consist of a large volume of sand dredged directly in place from the Connecticut River, provided with an impervious rolled fill blanket on the riverside extending to and around a steel sheet piling cut-off. A small rolled fill section of random material, which generally will be obtained from the cut-off trench excavation will provide a transition from the blanket to the pervious section. Between Grove Street and Wawarme Avenue it is anticipated that the pervious dike section will be enlarged to accommodate a boulevard on the top, and no drainage facilities have been provided for it in this project. When this wide section of dike is completed the seepage path will be long and the line of saturation will be well within the section. Where no future enlargements will be made, a landside toe drain will be provided which will tend to hold the saturation line within the pervious section and also will facilitate disposal of seepage to the City's drainage system and the proposed pumping station. Due to the proximity of the river, large dumped rock toes and hand-placed riprap will be provided on the riverside slopes which will be subject to erosion, scour and wave action on the full length of the dike. The dike section is considered stable at sudden draw-down of the river and other adverse conditions and affords adequate resistance against seepage. The dike will be constructed to satisfy the following criteria:

1. The crest of the dike is at such a grade that there is no danger of overtopping when the design flood occurs (Paragraph III A and B.)

2. The freeboard is sufficient to greatly reduce the danger of overtopping by waves. (Paragraph III B.)

3. The slopes of the dike are such that with the materials used in construction, they will be stable under all conditions. (Paragraph V B.)

4. The line of saturation is well within the landside toe (large pervious section and toe drain).

5. Water which passes through and under the dike will, when it comes to the surface, have a velocity so small that it is incapable of moving any of the material of which the dike and foundation are composed. (Paragraph IV A 5.)

6. There is no possibility for the free passage of water from the riverside to the landside face of the dike (sufficient impervious blanket).

7. No material soluble in water is used in any part of the dike. (Paragraph V B.)

8. The foundation is sufficiently stable to resist undue stresses caused by the embankment load. (Paragraph V B and V C.)

9. Seepage through the dike and foundation will be reduced to a total quantity well within economic pumping limitations. (Paragraphs IV A 5, B, and III D.)

B. LABORATORY INVESTIGATIONS.

1. Classification of materials. - The Providence District has adopted a convenient system of soil classification having rigidly stand-

ardized terms. In this classification soils are divided into 16 classes as shown graphically on Plate No. 30 and described in Table No. 2. Soils of uniform grain size are designated by even numbers, soils of variable grain size by odd numbers and grain size limits of materials follow the M. I. T. Classification except that the size demarcation between silt and coarse clay is not 0.002 mm. but varies from 0.006 mm. to 0.0006 mm.

2. Grain-size analysis. - Grain-size curves of samples were obtained by sieve and hydrometer tests run on representative samples for each stratum encountered in each exploration. These materials were classified and grouped into sedimentary units as shown on Plate No. 12 entitled "Transverse Geologic Sections". Plate No. 29 shows typical grain-size curves for embankment materials.

3. Water content and void ratio. - Water contents and void ratios were determined by means of paraffined cores and Shelby tube samples of foundation strata. In addition these tests were run on samples representative of borrow areas.

4. Permeability. - Permeability tests for embankment materials were obtained from falling head tests using tap water with air content reduced by tank storage.

5. Consolidation. - Consolidation tests were run on undisturbed samples obtained in ten 6-inch bore holes scattered throughout the Hartford area. These ten bore holes sampled the same general stratum of soft, red, varved clay and all results were considered in the analysis with somewhat more weight being given to results of BH-1A and BH-3A which occur nearest to this site. Consolidation characteristics for a typical sample are shown on Plates Nos. 32 and 33.

6. Shear.

a. Tests to determine the shearing resistance of embankment materials were made by the direct shear method allowing complete consolidation under normal loads with horizontal strain at a constant rate of 0.06" per minute. Typical results for the impervious and pervious borrow material are shown in Plates Nos. 34 and 35.

b. The shearing resistance of the soft clay in the foundation was determined by means of unconfined compression quick tests on undisturbed samples coated with vaseline to avoid capillary pressures. Results of a typical test are shown in Plate No. 36. Quick tests were also run by the direct shear method on undisturbed samples.

7. Compaction. - Compaction tests based on the Proctor analysis procedure and on Terzaghi's relative density method were performed on impervious and pervious embankment materials respectively. Plate No. 37 is a typical compaction curve for the impervious material. In addition to preliminary tests on borrow materials much data were available from control tests giving compacted weights actually attained by using materials from these same borrow areas in previous embankment work. These data were considered in compiling the compaction characteristics as summarized in Table No. 1 entitled "Summary of Materials Available."

8. Other tests. - Tests for extraction for solubility and specific gravity were performed.

C. SETTLEMENT AND SEEPAGE.

1. The foundation conditions are shown on Plate No. 29 entitled "Transverse Geologic Sections". In the northern portion of the project from Station 0+00 at Memorial Bridge southward to Keeney Lane at approximately

Station 25+00 the underground is composed of fill and granular sands and coarse silts above a layer of very compact glacial till which overlies the rock. No appreciable settlement is anticipated in the concrete wall and dike in this section. The only foundation problem in this section is one of seepage which has been reduced by a sheet pile cut-off extending through the fill.

2. South of Keeney Lane to the end of the project at Station 96+73 the upper 25 to 40 feet of the foundation is composed of fill, flood plain silt and medium sand. Beneath this is a layer of soft, red, varved clay 50 to 60 feet thick underlain by a formation of compact glacial till overlying rock. This clay is quite compressible but settlements are greatly reduced by the heavy thickness of overburden above the clay. Settlements of structures in this area are estimated in general at 5 inches for the dike and from 1 to 2 inches for the concrete walls. Seepage through this section of the project is reduced to a negligible amount by a sheet pile cut-off extending to the clay layer.

3. In the section between the Dutch Point Electric Plant and screen well, Stations 38+40 to 41+10, space is insufficient for adequate base width under the concrete wall and the wall rests on piles. Since these piles are required to take large uplift loads, long piles are used, driven through the clay to the compact glacial till above rock. In other short wall sections and at the Dutch Point and South Meadows Electric Plants piles are used either to transfer load through recent fills or because of narrow base width. These piles stop in the sand layer above the clay and thus avoid greater settlements which would be caused by driving piles into the clay and remolding it.

4. In the section from Station 42+00 to Station 44+00 where the dike crosses the existing channel of Park River the dike and channel fill reached a maximum height of 50 feet. As the overburden above the clay is only 10 to 15 feet thick in the existing river channel, large settlements are anticipated, a maximum of 23 inches estimated to occur at the centerline of dike. At this location the channel fill will be installed as first season construction and the closure section of dike, concrete walls, drains and sheet piling completed as second season construction. By this means nearly all of the settlement due to first season construction will have been completed before installation of the closure work. Consolidation of the soft clay foundation at this location will be greatly accelerated by vertical drain wells as discussed in the next section.

D. TREATMENT OF FOUNDATION BY DRAIN WELLS

1. At the confluence of the Park and Connecticut Rivers a heavy dike and channel fill (50 feet maximum height) is to be placed over a deposit of soft varved clay 40 to 55 feet thick. These underground conditions are shown in section on Plate No. 38. This section has been analyzed for stability by the Swedish method for a circular sliding surface and the most dangerous sliding surface located by contours of equal factors of safety. With no foundation treatment and for the dike constructed in one season the section is considered to be unstable.

2. After considering various changes in embankment section and in alignment a system of vertical drain wells for foundation treatment was adopted as the most economical and effective measure to increase this factor of safety. The function of these drain wells is to shorten the drainage path through which the pore water must move under the influence

of applied loads and thus accelerate the rate of consolidation. In most clays the direction of drainage is generally vertical, but with drain wells in place the bulk of the drainage is changed to a horizontal direction. The clay in this foundation is a varved material consisting of alternate layers of silt and clay which results in the overall permeability being much greater in a horizontal than in a vertical direction. Consequently, drain wells are very effective in this clay, causing the bulk of the pore water to drain horizontally through the more pervious silt layers.

3. It is proposed to fill in the channel of Park River as first season construction and then install the drain wells. After a period of approximately 9 months to allow for consolidation the second stage construction will be added to close the gap. The use of drain wells accelerates the rate at which the foundation becomes adjusted to load and causes a gain in shearing resistance sufficient to permit the completion of the dike within the desired 2-year construction program. Plate No. 39 shows predicted time-settlement curves with and without drain wells. Since the rate of consolidation equals both the rate of settlement and the rate of increase in shearing resistance, these time-settlement curves show the rate at which the clay gains strength. For a 2-season construction program with wells, as indicated in the load diagram on Plate No. 39, the section is considered to be stable with a factor of safety against a slide estimated to be 1.15.

4. The time-settlement curve on Plate No. 39 for the case without wells is based partly on the results of consolidation tests on undisturbed samples from ten 6-inch bore holes explored in the Hartford

Area and partly on the observed rate of settlement of the South Meadows Power Station which rests on this same stratum of clay. In estimating the rate with wells the case of drainage to a vertical slot was first considered and this rate then reduced by a ratio representing the efficiency well drainage vs. slot drainage. For horizontal drainage in varved clay the rate of settlement depends upon two variables:

a. Ratio of thickness of clay layers to that of silt layers.

b. Ratio of permeability of the clay to that of the silt. Based on probable variations in these two variables the predicted settlement for the case with wells is shown as a range between limiting curves for the maximum and minimum rates.

5. The drain wells are designed as 12" minimum diameter holes extending to the bottom of the clay and filled with tamped sand. Plate No. 40 entitled "Plan of Foundation Treatment and Park River Fill" shows a layout of wells which are spaced at the vertices of equilateral triangles to minimize overlapping in the zones of influence of adjacent wells.

a. Two possible methods for advancing the holes have been studied:

(1) Advance the hole by power auger or rotary cutting device using a heavy fluid or drilling mud without casing through the clay. Temporary casing would be installed only to seal off the pervious material above the clay. This is similar to the Powell method for installing caissons which was used successfully in the foundation work for South Meadows Power Station where caissons up to 6 feet in diameter and 70 to 90 feet deep were sunk through this same clay stratum.

(2) Drive an open-end casing or hollow mandrel through the clay, excavate by air or water jet and withdraw casing as sand backfill is placed and tamped.

b. The second method has the disadvantage that driving and extracting a casing would create a smear and a zone of remolded clay on the sides of the hole. As a result the silt layers are partially cut off by more impervious material in the remolded zone and the effective horizontal permeability is reduced. Since the first method does not have this disadvantage, it is proposed to commence operations by the first method using a rotary cutting device. A driven casing or mandrel will be resorted to only if the holes cannot be kept open by heavy fluid. The predicted settlement curves of Plate No. 39 are based on the more unfavorable case with a smeared zone resulting in holes advanced by a driven casing.

6. In the section treated by drain wells actual settlements will be obtained by observation on settlement gages. Piezometers and hydrostatic pressure cells will be installed to measure pore water pressures. These observations will determine the actual rate of consolidation and thus indicate when it is safe to add the fill comprising the second season construction.

VI. STRUCTURAL DESIGN

VI. STRUCTURAL DESIGN

A. GENERAL INFORMATION

1. Concrete walls. - The reinforced concrete flood walls will extend between the following stations: Morgan Street and Memorial bridge (Station 0+17.75) to Station 22+08 ± (200'± south of Grove Street) at junction with an earth dike; from dike at Park River Conduit (Station 35+54 ±) to Station 42+87 ± (present Park River) and beginning of dike; end of dike (Station 79+86 ±) to Station 92+34 ± at the beginning of the Clark Dike.

The "T" type cantilever wall and the counterfort walls used throughout this project were so selected to meet the existing conditions at the various sites. Some of the determining features were economy of construction, limiting space and existing structures. The walls are designed to resist a principal load coming from the assumed head of water taken to the top of the walls which is approximately 2 feet above the City of Hartford design flood stage, or 7 feet above the U. S. Engineers' design flood stage. The walls vary in height from 16 to 36 feet.

2. Stop-log structures. - Stop-log structure No. 1 is located at Station 85+39 ± and stop-log structure No. 2 at Station 87+58 ±. The stop-log structures were designed to resist a load coming from a head of water, equivalent to that used in the design of the walls.

3. Miscellaneous structures. - Miscellaneous concrete structures consist of a portion of the Keeney Lane Pumping Station outlet conduit with gate structure, the gate structure for the existing Potter Street Pumping Station outlet conduit, reconstruction of a portion of the existing Masseek Street sewer with gate house and back water chamber, and the flume for

Dutch Point Electric Station.

4. Architecture. - The structures and walls will be of modern design in keeping with the architectural treatment used on similar projects elsewhere on the Connecticut River. This design will give a pleasing appearance without undue emphasis being placed on purely decorative features.

B. GENERAL DESIGN DATA

1. General. - The structural design of the structures has been executed in accordance with standard practice. The specifications which follow cover the conditions affecting the design of the reinforced concrete and structural steel.

2. Unit weights. - The following unit weights for material were assumed in the design of the structure:

Water	62.5# per cubic foot
Dry earth	100 # " " "
Saturated earth	125 # " " "
Concrete	150 # " " "

3. Earth pressures. - Im computing active earth pressures, equivalent fluid pressures computed by the use of Rankine's formula were used. They are as follows:

Equivalent liquid pressure of dry earth = 35 pounds per cubic foot.

Equivalent liquid pressure for saturated earth = 80 pounds per cubic foot.

In computing passive resistances, Rankine's formula was used with the coefficient of internal friction = 35 degrees.

4. Hydrostatic uplift. -

a. Riverside of sheet piling

Full head due to headwater

b. Landside of sheet piling

(1) At landward toe, full head due to tailwater.

(2) At sheet piling, full head due to tailwater plus one-half the difference between headwater and tailwater.

(3) At intermediate points, the uplift was assumed to vary uniformly with the distance from the toe.

5. Overturning. - In general, the resultant of all external loads, including hydrostatic uplift and excluding base pressure, does not fall within the middle third under every condition but under no condition is the allowable bearing value of the soil exceeded. For walls with bearing piles, the resultant falls within the rear pile, except at the Dutch Point Station. In every case the pile specified is of sufficient strength to carry the maximum loading.

6. Sliding. - In general, the total horizontal forces due to external loads shall not exceed the resistance available from friction and passive resistance. The coefficient of friction used is 0.45. For walls with bearing piles, the horizontal forces due to external loads shall not exceed the resistance available from passive pressure and shear on the piles. At the Dutch Point Station most of the wall bases will be poured against the existing power house base to aid in preventing sliding.

7. Bearing. - The total bearing pressure, equal to the sum of hydrostatic pressure plus the remaining effective base pressure, shall in no case exceed the maximum allowable soil pressure, or pile loading.

8. Frost cover. - All footing bases shall lie at least 4 feet beneath the ground surface to avoid heaving by frost action.

9. Path of percolation. - Except where the steel sheet piling is either driven to rock or extended a minimum distance of 3 feet into an underlying stratum of impervious clay, the minimum path of percolation shall be four times the head of water.

10. Structural steel. - The design of structural steel was carried out in accordance with the Standard Specifications for Steel Construction for Buildings of the American Institute of Steel Construction.

11. Reinforced concrete. - In general, all reinforced concrete was designed in accordance with the "Joint Committee on Standard Specifications for Concrete and Reinforced Concrete" issued in January 1937, and with the "Joint Code of the American Concrete Institute and the Reinforcing Steel Institute for the Design of Concrete and Reinforced Concrete" issued in 1928.

a. Allowable working stress. - The allowable working stress in concrete used in the design is based on a compressive strength of 3,000 pounds per square inch in 28 days.

	Lbs. per sq. in.
b. Flexure (f_c). -	
Extreme fibre stress in compression	800
c. Shear (v). -	
Beams with no web reinforcement and without special anchorage	60
Beams with no web reinforcement but with special anchorage of longitudinal steel.	90

Lbs. per. sq. in.

Beams with properly designed web reinforcement but without special anchorage of longitudinal steel 180

Beams with properly designed web reinforcement and with special anchorage of longitudinal steel 270

d. Bond (u). -

In beams, slabs, and one way footings 150

Where special anchorage is provided 300

The above stresses are for deformed bars.

e. Bearing (f_c). -

Where a concrete member has an area at least twice the area in bearing 500

f. Axial compression (f_c). -

Columns with lateral ties 450

g. Steel stresses. -

Tension 18000

Web reinforcement 16000

h. Protective concrete covering. -

Type of members	Minimum cover in inches
Members poured directly against the ground	4
Members exposed to earth or water but poured against forms	3

For secondary steel, such as temperature and spacer steel, the above minimum cover may be decreased by the diameter of the temperature or spacer steel rods.

C. BASIC ASSUMPTIONS FOR DESIGN

1. Flood walls. - a. Cantilever walls. - The stem and base were designed for loads from hydrostatic pressure to the top of the wall and also for earth pressures due to anticipated fill on the landside face.

b. Counterforted walls. - (1) Stem and base. - The stem and base slabs were designed as continuous beams supported at the counterforts. The extension of the base slab on the opposite side of the stem from the counterforts was designed as a cantilever beam.

(2) Counterforts. - The counterforts were designed with consideration for anticipated loadings. In general, they will act as compression buttresses at flood stages and as tension counterforts at normal river stages.

(3) Stop-log structures. - The structures have an opening spanned by wooden stop-logs. These logs are held in place by grooves in the abutments. The structures were investigated for stability for two conditions of loading; one with the river at flood stage and one with the river down. The base is designed to take up stresses transmitted to it by the abutments which act as counterfort sections.

(4) Conduits. - The conduits were designed for bursting pressures with the river at maximum flood stage where this condition exists, and for earth loading of the fill over the conduits with water level at normal river stage. The gate chamber was designed for thrusts resulting from river flow at maximum flood stage and for lateral earth pressures.

VII. CONSTRUCTION PROCEDURE

VII. CONSTRUCTION PROCEDURE

A. SEQUENCE OF OPERATIONS. - It is assumed that construction will be started about August 1, 1940. It is estimated that it will require about 450 calendar days to complete all of the work. The major portion of the earth dike volume will consist of free draining river sand dredged from the Connecticut River. Due to lack of storage space it will be necessary to place practically all of the river sand directly within the final dike section. It is assumed that dredging will continue to Elevation 40 m.s.l. and that only the top section will be placed by rolled fill methods. Material to be used for this portion will be stockpiled near the top outside the neatlines of the dike. Due to the magnitude of the project it would be impossible to effect any degree of protection in the short time between August 1, 1940 and the usual occurrence of spring floods the following year. It will therefore be desirable to confine the first season's construction to such features which will not be damaged by flood waters occurring between the two construction seasons. Such features would be concrete walls, steel sheet piling, concrete piling, rock toes, riprap, etc. and it is therefore assumed that as much of these items as possible will be constructed during 1940, and that all embankment construction be deferred to the second season. Winter operation will be possible, but it will be restricted to placement of riprap, driving of sheet steel piling, concrete work, and such other items of work that may be carried on in the winter months. Construction of the embankment, completion of the concrete wall construction, placement of topsoil, sodding and seeding, etc., will be carried on as soon as weather permits in the spring of 1941. All work will be completed by November 1, 1941.

B. <u>CONSTRUCTION PERIOD.</u> - The record of flood stages is available for Hartford for a period in excess of 100 years. Continuous river stages have been kept for a little over 40 years. Historical flood records are available for slightly over 300 years. A study of hydrographs plotted from data recorded by the United States Weather Bureau from 1917 to 1938, a total of 22 consecutive years, Plates Nos. 2 and 3 shows that the majority of the floods at Hartford occur in the spring months of March, April and May although floods can occur in any month. The records show that the average peak of spring floods is Elevation 21 m.s.l. This elevation was greatly exceeded only once in this period when in March 20, 1936, the river reached a height of 37.6 feet. Fall floods have also occurred in excess of Elevation 21, the greatest in the period mentioned being that of September 21, 1938 reaching a stage of 35.4 feet. The average elevation of the ground on the centerline of the dikes and walls is 25 m.s.l., sloping to an average elevation of 14 m.s.l. at the river's edge. The fore shore, or the greater portion of the work area, therefore, is subject to flooding every year during the spring months; however, the possibility of high water reaching any considerable portion of the work area during the period June 1st to December 1st is small. As determined from the above study it would seem logical to bring the permanent construction to a stage of completion to Elevation 25 m.s.l. by the end of the first construction season. However, due to the magnitude of the project this procedure would not be practical. It has therefore been determined to concentrate work during the first season on such items as will not be damaged by flood waters between first and second construction seasons. (See Paragraph VII A.)

The following schedule shows the major items of work involved, the approximate quantities and planned construction period for each.

FIRST SEASON - 1940

Item	From	To	No. of Working Days	Quantities	Average Daily Rate
1. Prep. of site, found. exc.	Aug. 1	Dec. 1	80	84,000 cy	1,050 c.y.
2. Steel sheet piling	Aug. 15	Nov. 1	50	282,000 sf	5,640 s.f.
3. Concrete piling	Aug. 15	Dec. 1	70	22,000 lf	320 l.f.
4. Concrete structures	Aug. 15	Dec. 1	70	8,700 cy	125 c.y.
5. Dumped rock toe	Aug. 1	Dec. 1	80	48,600 cy	610 c.y.
6. Riprap	Sept. 1	Jan. 1	80	8,600 cy	110 c.y.
7. Drainage system	Sept. 1	Jan. 1	80	1,600 lf	20 l.f.
8. Dredging, Park River fill.	Oct. 10	Nov. 1	20	* 180,000 cy	9,000 c.y.
9. Vertical drains, Park R.	Nov. 1	Jan. 1	40	8,400 lf	210 l.f.
SECOND SEASON - 1941					
Preparation of site, found. exc.	May 1	Sept. 1	80	37,000 cy	460 c.y.
Dredging, dike and fills	May 1	Sept. 1	80	* 455,000 cy	5,700 c.y.
Borrow excavation, imper.	June 1	Oct. 1	80	134,000 cy	4,030 c.y.
Emb. blanket construction	June 1	Oct. 1	80	116,000 cy	1,450 c.y.
Concrete structures	May 1	Oct. 1	100	13,100 cy	131 c.y.
Riprap	May 1	Oct. 1	100	13,000 cy	130 c.y.
Drainage system	May 1	Oct. 1	100	2,400 lf	24 l.f.
Miscl. Items	Sept. 1	Nov. 1	40		
Job complete		Nov. 1			

* These quantities are net volumes in place.

C. CONSTRUCTION DETAILS. - In two construction areas, namely in front of the Dutch Point Station and the South Meadows station of the Hartford Electric Light Company, there are many difficult construction problems. Generally, these problems have been solved in cooperation with officials of the Light Company, and all known details have been shown on the drawings. The execution of this work, however, is subject to approval by the company and the work must be carried on in such a manner that no interruption of the normal operations of the stations occur. It is therefore believed that the work in these areas will be slow and that the contractor's operations will take place during both construction seasons. Therefore only very general statements as to the detailed work in these areas can be given beforehand.

The Park River conduit which crosses the riverfront dike immediately north of the Dutch Point power station, will be constructed under a separate contract. A work area for this project has been designated, and it is a foregone conclusion that the dike contractor will have no access to this area until the work is concluded. It is anticipated that the Park River, which joins the Connecticut River south of Duth Point, will be diverted through the conduit about November 1, 1940. These facts should be borne in mind when the following detailed description of the items of work is analyzed.

1. Preparation of site and foundation excavation. - The preparation of site consists of clearing and grubbing for the embankment and concrete structures. Except for special construction at the South Meadows station and the Dutch Point station of the Hartford Electric Co., removal of public utilities from the site of the work will be made

by their respective owners. Foundation excavation will be closely followed by driving of steel sheet piling, earth and concrete construction.

2. Steel sheet piling. - Complete cut-off by steel sheet piling has not been effected in the full length of the dike. Adequate drains have been provided to take care of seepage. However, the City of Hartford favors complete cut-off and additional steel sheet piling has been added on the City's request. The steel sheet piling will be driven to place in advance of earth or concrete construction.

3. Concrete piling. - The walls which will be supported on concrete piling are confined to the area in front of the Dutch Point station and a small area in front of the South Meadows station. Since construction in these areas is contingent on continued operation of the electric power stations it is anticipated that the concrete piling be driven as early in the first season as possible in order to allow sufficient time for the remainder of the construction. For the purpose of uniformity in bidding, precast concrete piling has been called for on the drawings. Alternate bids will be asked for cast-in-place piles and the selection will depend on the prices obtained. Due to the size and length of the piles only modern and efficient equipment will be allowed in performance of the work.

4. Concrete structures. - The concrete flood walls will generally be of the cantilever type with expansion joints at 40-foot intervals. Extremely high walls will be of the counterfort type with counterforts spaced approximately 13 feet and expansion joints 40 feet. Copper water stops and expansion joint materials will be used to effect continuous water-tight protection. Generally the footings for the

concrete walls are above ground water level; however, in front of the electric power stations cofferdams will be required. Temporary steel sheet piling as well as timber piling will be required in some places adjacent to railroad tracks in order to insure continued train operation. The concrete wall construction will commence at the beginning of the first season and may be completed at any time during the second season. It will be required that all portions of the walls, which will be buried in the embankment be completed during the first season. Other concrete structures consist of the outlet conduit for the Keeney Lane Pumping station and the reconstruction of the Masseek Street Sewer. These structures must be completed during the first season, while the gate house at Masseek Street and the gate structures at Keeney Lane conduits above the final dike section may be completed at the contractor's convenience. The stop-log structures are small and of minor importance as construction items.

5. Dumped rock toe. - Due to the close proximity of the dike to the river large sections of rock toes are necessary. In order to insure completion of the project within the time scheduled, it is of major importance that the rock toes be placed during the first construction season. All rock will be obtained from commercial sources. Concrete blocks obtained by removal of existing foundations may be used in the rock toes if approved by the contracting officer.

6. Riprap. - It will be desirable, although not required, that the riprap protection follows the embankment construction as closely as possible. All work done on the riverbank during the first season should be protected with riprap before the spring floods occur. Riprap

can be placed during the winter months. The rock will be well bedded in gravel and be secured by tightly driven spalls. Riprap and gravel will be obtained from commercial sources.

7. Drainage systems. - The drainage systems consist of pipe, grouted gutters and concrete structures. Construction of the drainage systems will progress as rapidly as practicable to avoid excessive construction of temporary drainage structures.

8. Borrow dredging. - The major portion of the pervious embankment will be obtained from the river by dredging sand directly in place. Some stockpiling will be necessary for construction of rolled fill at the dike-wall connections and for backfill and bank treatment. The pervious embankment construction will commence as soon as possible in the second construction season. It is anticipated that the pervious section between Grove Street and Wawarme Avenue will be enlarged to accommodate a boulevard to be located on top of the dike. The outline of the additional sand required has not been shown on the contract drawings, however, the material may be placed by the dike contractor under a separate agreement with the City of Hartford. The additional sand required will amount to approximately 300,000 cubic yards. In addition to the pervious embankment, free draining river sand obtained by dredging operations will be used at the future commercial wharf at Wawarme Avenue for fill in the abandoned portion of the Park River near Dutch Point and for backfill in other designated areas. It is anticipated that the downstream portion of the Park River conduit which will be constructed under a separate contract, will be ready for diversion of the downstream portion of the Park River in the fall of the first

construction season. As soon as the river has been diverted through the conduit the old river bed will be dredged full of sand to Elevation 26 m.s.l. to the toe of the landside slope of the dike sloping to Elevation 10$\pm$ m.s.l. at the river edge and the rock toe and riprap will be placed for protection, in order that the system of vertical gravel drains extending through the underlying clay can be constructed during the winter. The remainder of the Park River fill will be placed to the ultimate elevation of 26 m.s.l. and the dike constructed during the second construction season.

9. Borrow excavation. - Embankment material not supplied by dredging or from foundation excavation will be obtained from designated impervious borrow areas. No stockpiling of borrow material for the impervious blanket is anticipated. Structure excavation, if found suitable, will be used in the small random section of the dike. Some borrow or random material may be required. The random section of the dike will be rolled.

10. Embankment blanket construction. - Following the operation of driving the steel sheet piling, the cut-off trench will be backfilled with impervious material. Pneumatic tampers will be employed in places not accessible to rolling equipment. This operation can take place during the first construction season but it will undoubtedly be found advantageous to leave gaps for the return of dredge water to the river. Upon completion of the pervious section of the dike in the second construction season, the blanket will be completed to grade by the rolled fill method.

11. Vertical gravel drains. - These drains are located at the existing mouth of the Park River. The purpose of the drains is to effect a rapid consolidation of the underlying layer of varved clay thereby preventing failure of the embankment by sliding. See criterion 8, Paragraph V A, C and D. Construction must take place toward the end of the first construction season. It is expected that about 3 drains can be completed per day and that all drains will be completed by January 1, 1941. The coarse sand to be used will be obtained from the dredged river sand by selection.

12. Miscellaneous items. - The miscellaneous items consist of top-soil, sodding and seeding, installation of gate valves, miscellaneous iron and steel, pipe lines, bulkhead construction, timber piling, etc. and general clean-up of the site. Most of these items are integral parts of the major items described above and must be installed or constructed in the proper sequence. Sodding and seeding will be done in accordance with recommended practice and careful attention must be given the areas treated through the early stages of growing.

D. LABORATORY AND FIELD TESTS DURING CONSTRUCTION.

1. Embankment construction. - The Soils Laboratory at Providence, Rhode Island, and the field soils laboratory at East Hartford, Connecticut, will perform the necessary tests to investigate and record the characteristics of the types of soil used in construction. Tests will be performed to determine the mechanical classifications of soils, water contents and density of material in place and compaction characteristics of borrow material. Supplementary shear and permeability tests will also be made.

The embankment will consist of three types of materials, impervious, random and pervious fill. All ramps will be built of pervious material on the landside and impervious material on the riverside. Screened gravel as used for the toe drain and bedding for riprap will be obtained from commercial sources and will not be subject to rigid laboratory tests. The types of materials intended for embankment fill and their placement will be subject to close control before and during construction. It will also be required that the equipment used in the construction of the embankment will be maintained in good operating condition at all times.

Settlement observations will be made to check actual settlements against predicted values. In the soft clay foundation treated with drain wells at the mouth of Park River, observations on settlements and pore water pressures will be carefully conducted to determine the actual rate of consolidation as accelerated by the drain wells.

2. <u>Concrete construction</u>. - Materials used in the making of concrete will be tested at the Central Concrete Testing Laboratory, West Point, New York. The field tests will principally be used for control of the quality of concrete during construction. Facilities will be available for grading the aggregates, designing mixes, making of slump tests and for casting and curing concrete cylinders for compression tests.

Cement will be tested by a recognized testing laboratory and results of these tests will be known before the cement is used; only one brand will be used throughout at each location. Fine and coarse aggregates will be obtained from approved commercial sources. The amount of water used for each batch of concrete will be predetermined; it will, in general, be the minimum amount necessary to produce a plastic mixture of the strength specified. Storage of cement and aggregates, mixing and placing of concrete as well as placing of reinforcement steel will be supervised and directed by Government inspectors.

VIII. SUMMARY OF COST

VIII. SUMMARY OF COST

The total construction cost of the Hartford Riverfront Dike from Station 0+00 at Morgan Street to Station 96+73 at the end of the recently completed Clark Dike has been estimated to be $1,907,000, which includes 10 percent for contingencies and 15 percent for engineering and overhead. The cost does not include the cost of land, pumping station, any part of the Park River Conduit, railroad relocation or relocation of public utilities except as noted below. This construction cost of $1,907,000 includes special features in the estimate as:

Construction of a concrete flume and pipe relocations at Dutch Point and South Meadows Stations of the Hartford Electric Light Company, reconstruction of the Masseek Street sewer with gate house and backwater chamber, construction of a portion of the outlet conduit for the pumping station with gates and gate structures, dredged fill for the abandoned channel of the Park River, and dredged fill for a future commercial wharf at Wawarme Avenue.

The Government's share of the above cost has been estimated to be $920,000. This is the estimated cost of flood protection works only, including protection of Dutch Point and South Meadows Stations to the grade recommended by the Board of Engineers for Rivers and Harbors.

There follows a list of the major divisions of work involved and their relative costs:

1.	Excavation.	$ 76,000
2.	Embankment.	329,000
3.	Miscellaneous fills	87,000
4.	Concrete features	602,000
5.	Drainage systems.	8,000
6.	Steel sheet piling.	360,000
7.	Concrete piling	68,000
8.	Dumped rock toes, hand-placed riprap.	319,000
9.	Miscellaneous	38,000
		$1,907,000

1. The item of excavation includes all stripping, excavation for concrete structures, drainage ditches, cut-off trench including necessary temporary shoring and sheeting.

2. The embankment item includes all borrow excavation and fill for the dike structure with cut-off trench and toe drains, including such other items as vertical drains for foundation treatment at Park River, topsoil, sodding and seeding, road surfacing and ramp construction.

3. Miscellaneous fills include all backfill at concrete walls and other structures, pervious dredged fill for the Park River channel and the future commercial wharf at Wawarme Avenue.

4. The item of concrete features includes all form work, cement, concrete and imbedded items such as reinforcement steel and copper water stops.

5. The drainage systems include furnishing and placing of all tile pipe, cast iron drainage pipes and grouted stone gutters.

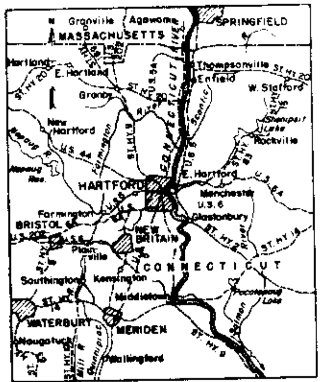
6. Steel sheet piling includes the furnishing and driving of piling for the cut-off and the bulkhead.

7. The estimate for concrete piling is based on precast concrete piling and includes furnishing and placing.

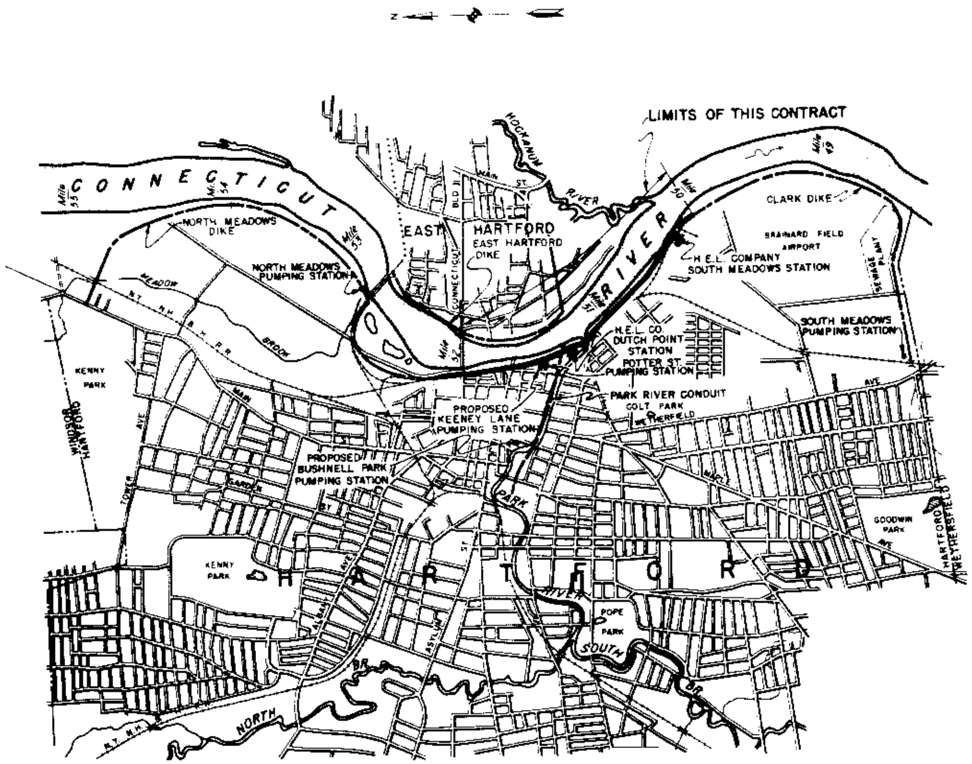
8. The item of dumped rock toes and hand-placed riprap includes gravel bedding for riprap and furnishing and placing all rock required for the project, except grouted gutters.

9. The miscellaneous item covers estimates for gate house features, gates and hoists, miscellaneous pipes, preparation of site, and all estimates of work not included under items 1 to 8 inclusive as shown above.

INDEX OF PLATES



LOCATION MAP
SCALE 1 IN.=8 Miles



VICINITY MAP

LEGEND

- Contract
- Completed
- Under construction
- Proposed

CONNECTICUT RIVER FLOOD CONTROL
HARTFORD DIKE
RIVERFRONT, MORGAN ST. TO STA 96+73
PROJECT LOCATION AND INDEX

CONNECTICUT RIVER — CONNECTICUT
IN 126 SHEETS — SCALE 1 IN.=2000 FT — SHEET NO. 1

U.S. ENGINEER OFFICE, PROVIDENCE, R.I. — MAY, 1940

SUBMITTED — APPROVAL RECOMMENDED — APPROVED
SENIOR ENGINEER HEAD DESIGN SECTION — PRINCIPAL ENGINEER CHIEF, F.C. ENGINEERING DIV. — LT. COL., CORPS OF ENGINEERS DISTRICT ENGINEER
DESIGNED — DRAWN — TRACED — CHECKED — ASSOC. ENGINEER
FISCAL YEAR 1940
FILE NO. CT-4-2638

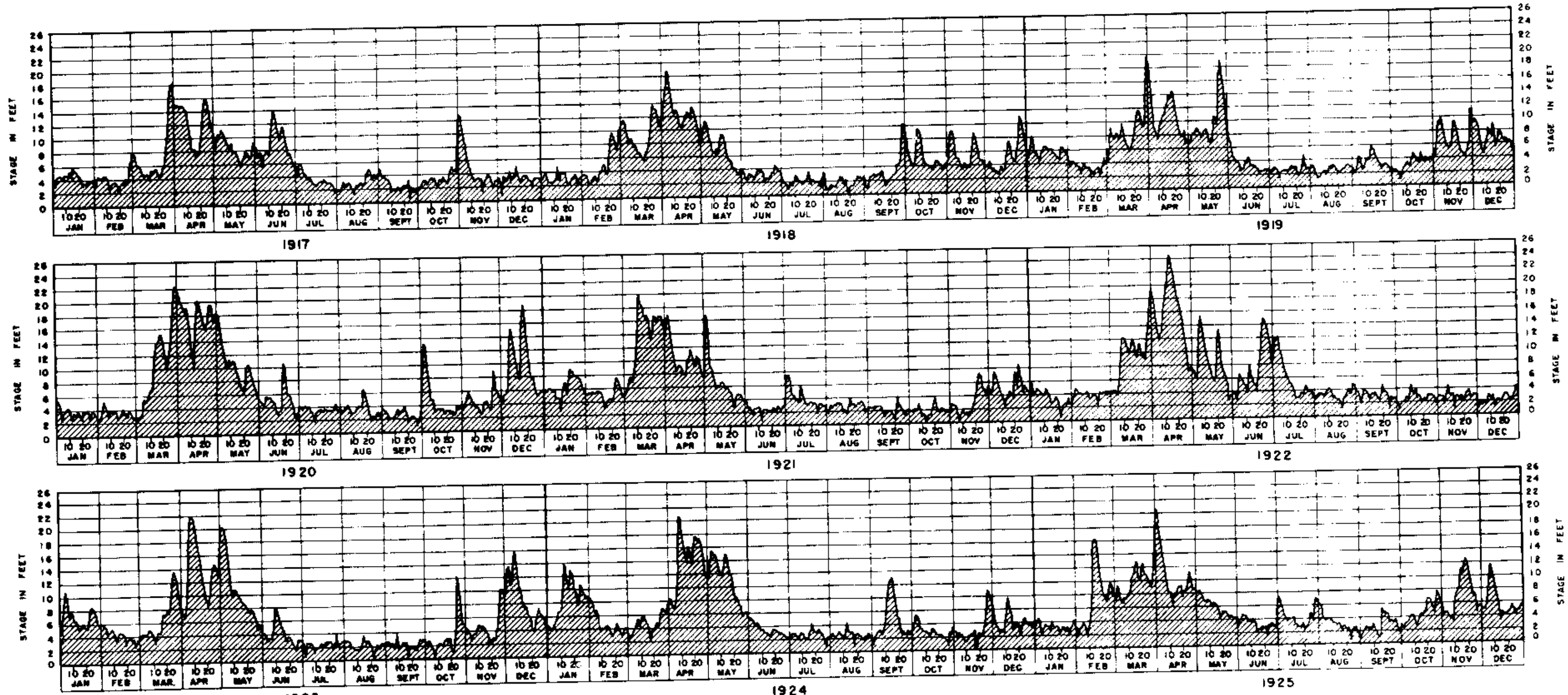
DATE	REVISION	REV BY	CK BY	AP BY

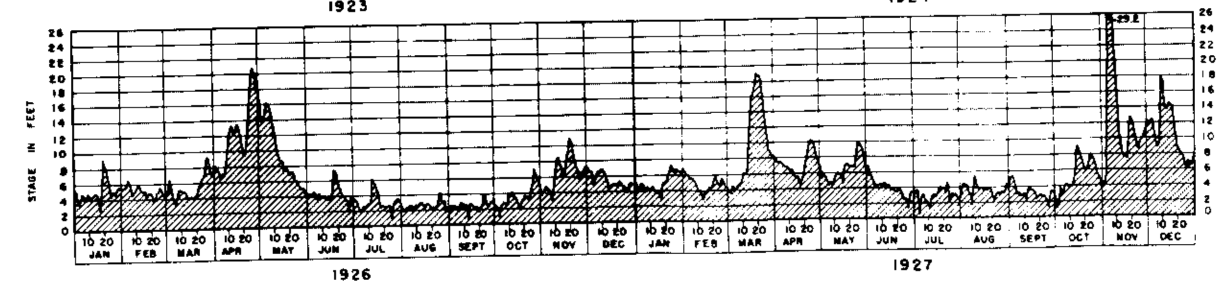
A. of D. Ht. 5876

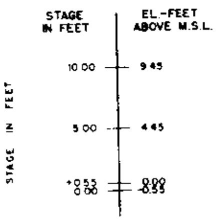
PLATE NO. 1

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY.







STAGE-ELEVATION RELATION

NOTES:

Low stages are subject to tidal fluctuation which has a mean amplitude 0 at a stage of 7 feet and 1.5 feet at a stage of 2 feet

Stage readings on Hartford gage, zero = -0.55 M.S.L.

Data supplied by U.S. Weather Bureau

Gage located on downstream side of Memorial Bridge (Connecticut Boulevard)

DATE	REVISION	REV.BY	CK BY	AP.BY

CONNECTICUT RIVER FLOOD CONTROL

HARTFORD DIKE

RIVERFRONT, MORGAN ST TO STA 96+73

HYDROGRAPHS NO. 1

CONNECTICUT RIVER — CONNECTICUT

IN 128 SHEETS — SCALE AS SHOWN — SHEET No. 3

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., MAY 1940

SUBMITTED: ENGINEER, HEAD HYDRAULICS SECTION — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, F.C. ENGINEERING DIV. — APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

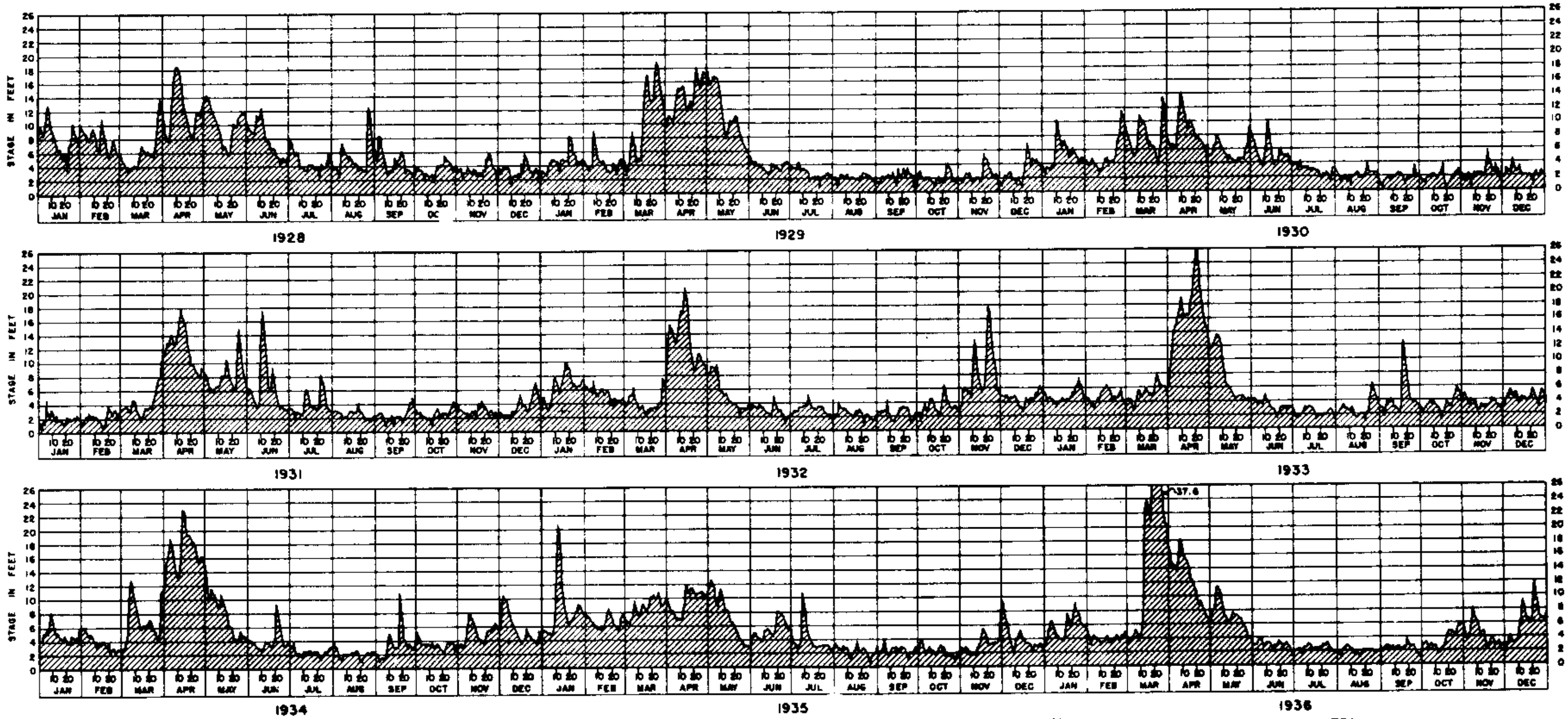
COMPILED: ASSOC. ENGINEER — DRAWN BY — TRACED BY — CHECKED BY — FISCAL YEAR 1940 — FILE NO. CT-3-[illegible]

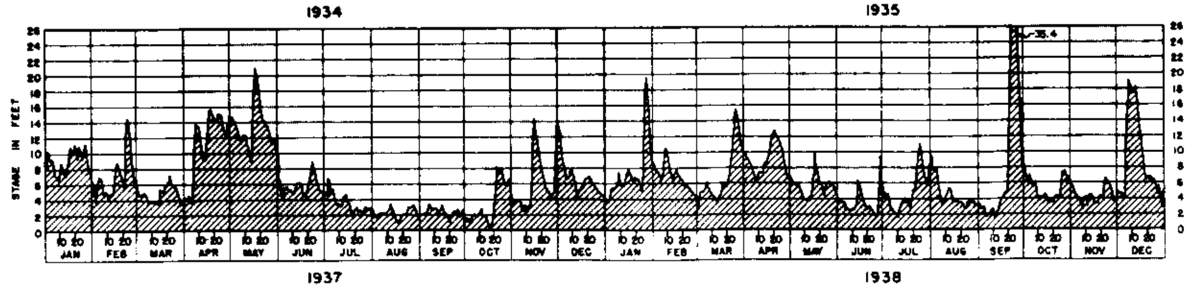
H1.5876

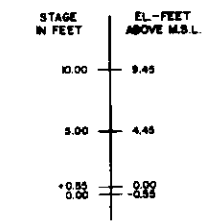
PLATE NO. 2

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY







STAGE-ELEVATION RELATION

NOTES:

Low stages are subject to tidal fluctuation which has a mean amplitude 0 at a stage of 7 feet and 1.5 feet at a stage of 2 feet

Stage readings on Hartford gage, zero -0.55' M.S.L.

Data supplied by U. S. Weather Bureau

Gage located on downstream side of Memorial Bridge (Connecticut Boulevard)

CONNECTICUT RIVER FLOOD CONTROL

HARTFORD DIKE

RIVERFRONT, MORGAN ST. TO STA 96+73

HYDROGRAPHS NO. 2

CONNECTICUT RIVER		CONNECTICUT
IN 128 SHEETS	SCALE AS SHOWN	SHEET NO 4
U. S. ENGINEER OFFICE, PROVIDENCE, R. I., MAY 1940		
SUBMITTED: HEAD, HYDRAULICS SECTION	APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, F. C. ENGINEERING DIV.	APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER
COMPILED:	DRAWN BY / TRACED BY / CHECKED BY	FISCAL YEAR 1940 / FILE NO. CT-3- 72

DATE	REVISION	REV. BY	CK BY	AP BY

PLATE NO. 3

Ht 58.7b

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY

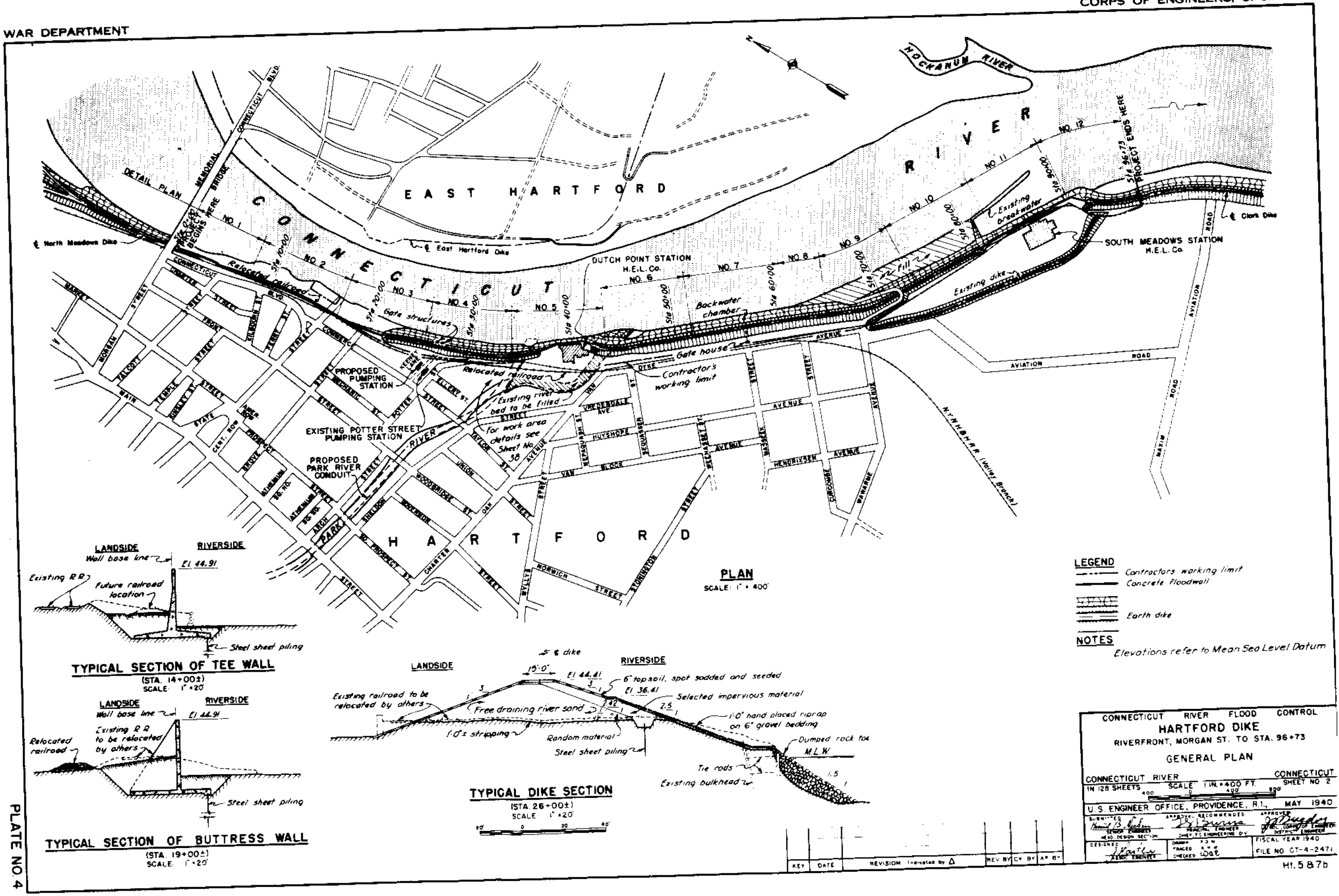
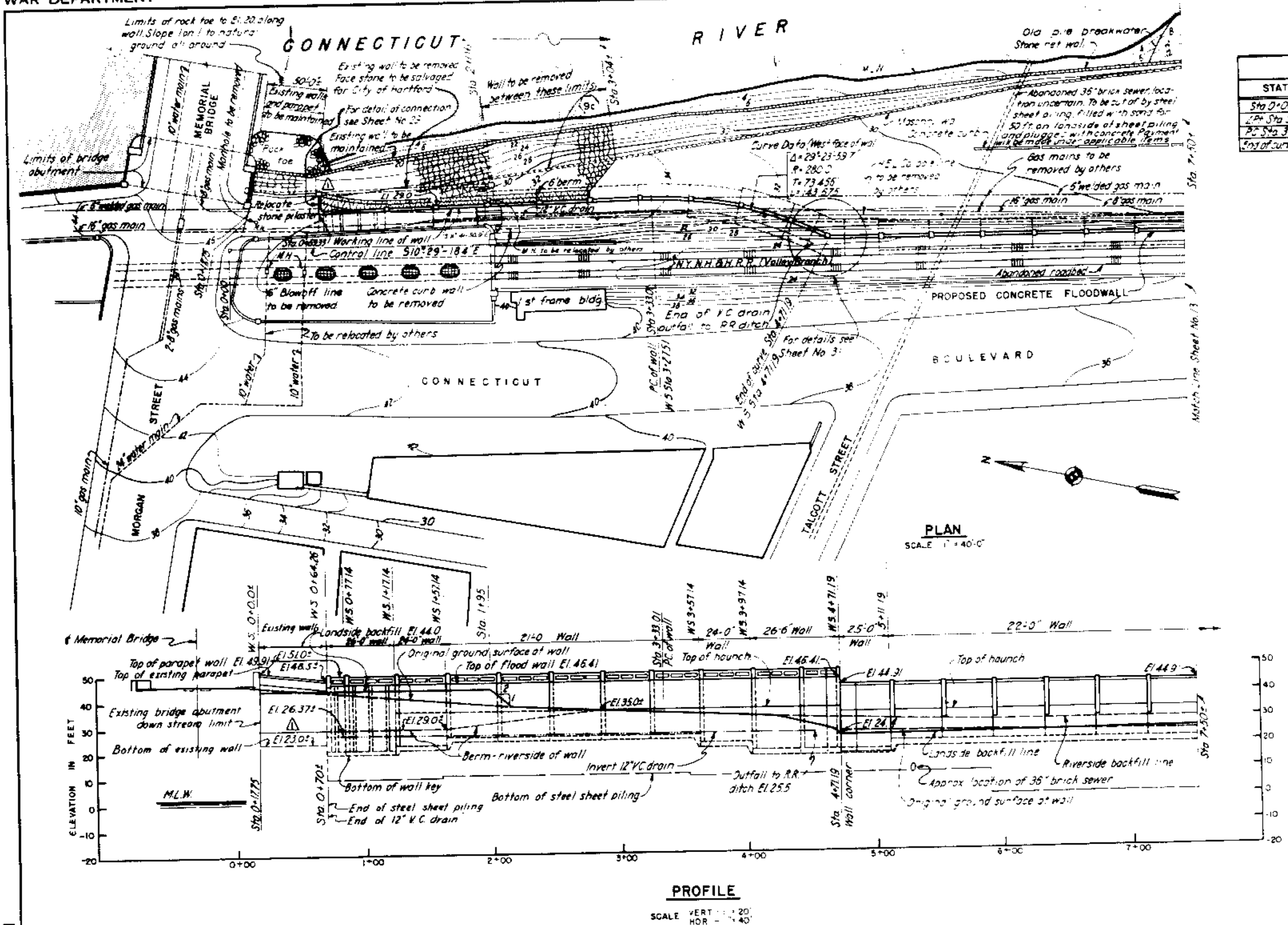


PLATE NO. 4

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



STATION COORDINATES		
STATION	NORTHINGS	EASTINGS
Sta 0+00	N-52702.72	E-70426.80
LP Sta 0+42.71	N-52565.55	E-70461.15
PC Sta 3+33.01	N-52381.31	E-70520.03
End of curve Sta 4+71.19	N-52239.40	E-70512.38

NOTES

All elevations refer to Mean Sea Level Datum.

Any sewers, utilities, etc not shown on the drawings and within limits of proposed structures shall be treated as directed by the Contracting Officer, payment will be made under applicable items.

All overhead wires will be removed by others.

Stations noted W.S. are taken along west face of proposed wall where control line and west face of wall do not coincide.

All buildings within the limits of proposed structures to be removed by others to ground level.

Foundation walls, floor slabs, footings, etc to be removed as directed by the Contracting Officer.

Coordinates refer to City of Hartford System.

For details of steel sheet piling see Sheets No 77, 78, 79, 80, 81, 82.

KEY	DATE	REVISION Indicated by △	REV BY	CK BY	AP BY
△	8-26-40	Length of wall reduced			

CONNECTICUT RIVER FLOOD CONTROL

HARTFORD DIKE

RIVERFRONT, MORGAN ST TO STA 96+73

PLAN AND PROFILE NO 1

CONNECTICUT RIVER IN 128 SHEETS — SCALE 1" = 40 FT — CONNECTICUT SHEET NO. 12

U. S. ENGINEER OFFICE, PROVIDENCE, R.I., MAY 1940

SUBMITTED: SENIOR ENGINEER, HEAD, DESIGN SECTION — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, F.C. ENGINEERING DIV. — APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

DESIGNED: ASSOC. ENGINEER — DRAWN — TRACED — CHECKED

FISCAL YEAR 1940

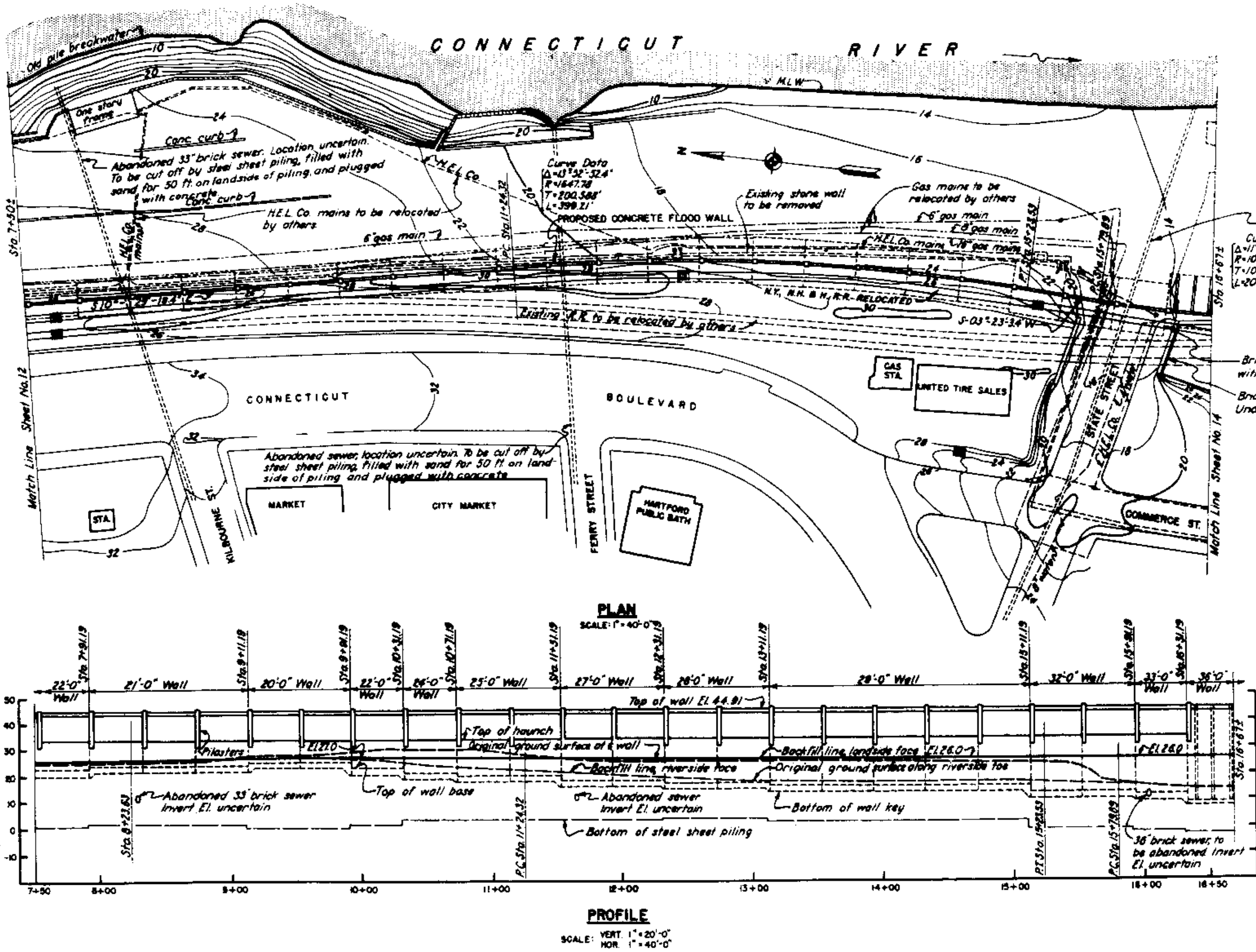
FILE NO CT-4-2472

H1.587b

PLATE NO. 5

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



STATION COORDINATES		
STATION	NORTHINGS	EASTINGS
P.O.T. Sta. 8+23.63	N- 51892.85	E-70576.74
P.C. Sta. 11+24.32	N- 51597.18	E-70631.47
P.T. Sta. 15+23.53	N- 51199.71	E-70656.12
P.C. Sta. 15+79.89	N- 51143.45	E-70652.78

NOTES

For general notes applying to this sheet see Sheet No. 12

Alignment data refers to west face of proposed walls

Payment for treatment of sewers shown on this sheet will be made under applicable items.

KEY	DATE	REVISION (Indicated by Δ)	REV. BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL

HARTFORD DIKE

RIVERFRONT, MORGAN ST TO STA 96+73

PLAN AND PROFILE NO 2

CONNECTICUT RIVER IN 128 SHEETS — SCALE: 1 IN. 40 FT — CONNECTICUT SHEET NO. 13

U.S. ENGINEER OFFICE, PROVIDENCE — 1940

SUBMITTED: SENIOR ENGINEER HEAD DESIGN SECTION — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER CHIEF F.C. ENGINEERING — ENGINEER — YEAR 1940

DESIGNED: ASSOC. ENGINEER — DRAWN: — TRACED: — CHECKED:

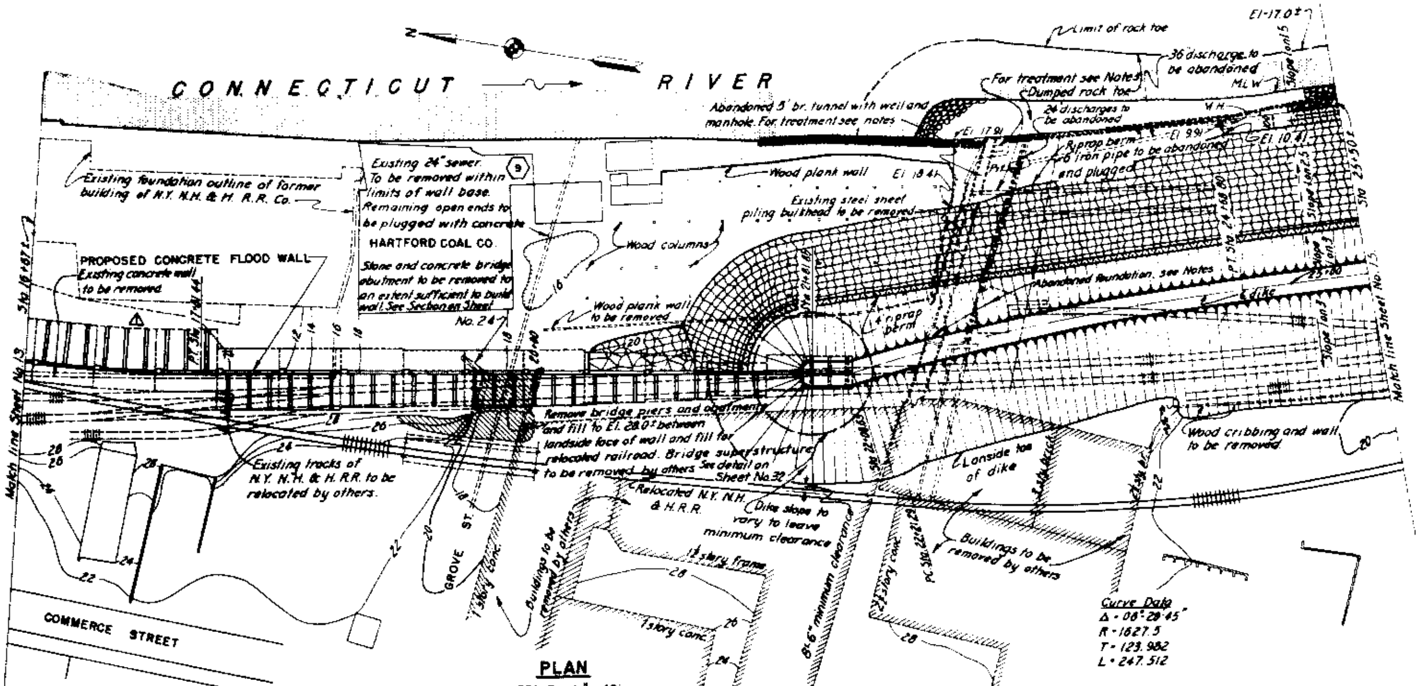
C.CT-4-2473

Ht. 5 87b

PLATE NO. 6

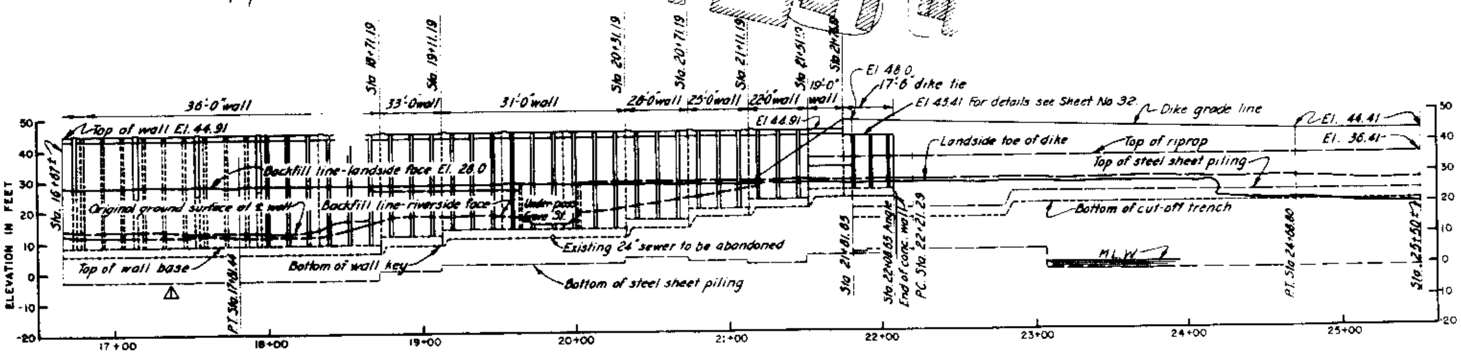
WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



PLAN

SCALE 1" = 40'



PROFILE

SCALE: HOR. 1" = 40'
VER. 1" = 20'

STATION COORDINATES		
STATION	NORTHINGS	EASTINGS
P.T. Sta. 17+81.44	N-50942.44	E-70661.14
POT Sta. 21+81.85	N-50546.05	E-70717.94
∠ Sta. 22+08.65	N-50519.52	E-70721.75
P.C. Sta. 22+21.29	N-50508.01	E-70726.97
P.T. Sta. 24+68.80	N-50275.88	E-70812.20

NOTES

For general notes see Sheet No. 12.

Well for 5' tunnel and abandoned foundation to be filled with suitable material. (8)

Abandoned 5' tunnel, 24" and 36" discharge pipes, manholes, and pits, to be filled with sand and plugged as directed by the contracting officer. (8)

Alinement data refers to West face of proposed walls.

KEY	DATE	REVISION Indicated by Δ	REV BY	CK. BY	AP BY
Δ	8-26-40	Counterforts changed			

CONNECTICUT RIVER FLOOD CONTROL

HARTFORD DIKE

RIVERFRONT, MORGAN ST. TO STA 96+73

PLAN AND PROFILE NO. 3

CONNECTICUT RIVER — CONNECTICUT

IN 128 SHEETS — SCALE: 1 IN. = 40 FT. — SHEET NO. 14

U. S. ENGINEER OFFICE, PROVIDENCE, R.I. — MAY 1940

FISCAL YEAR 1940

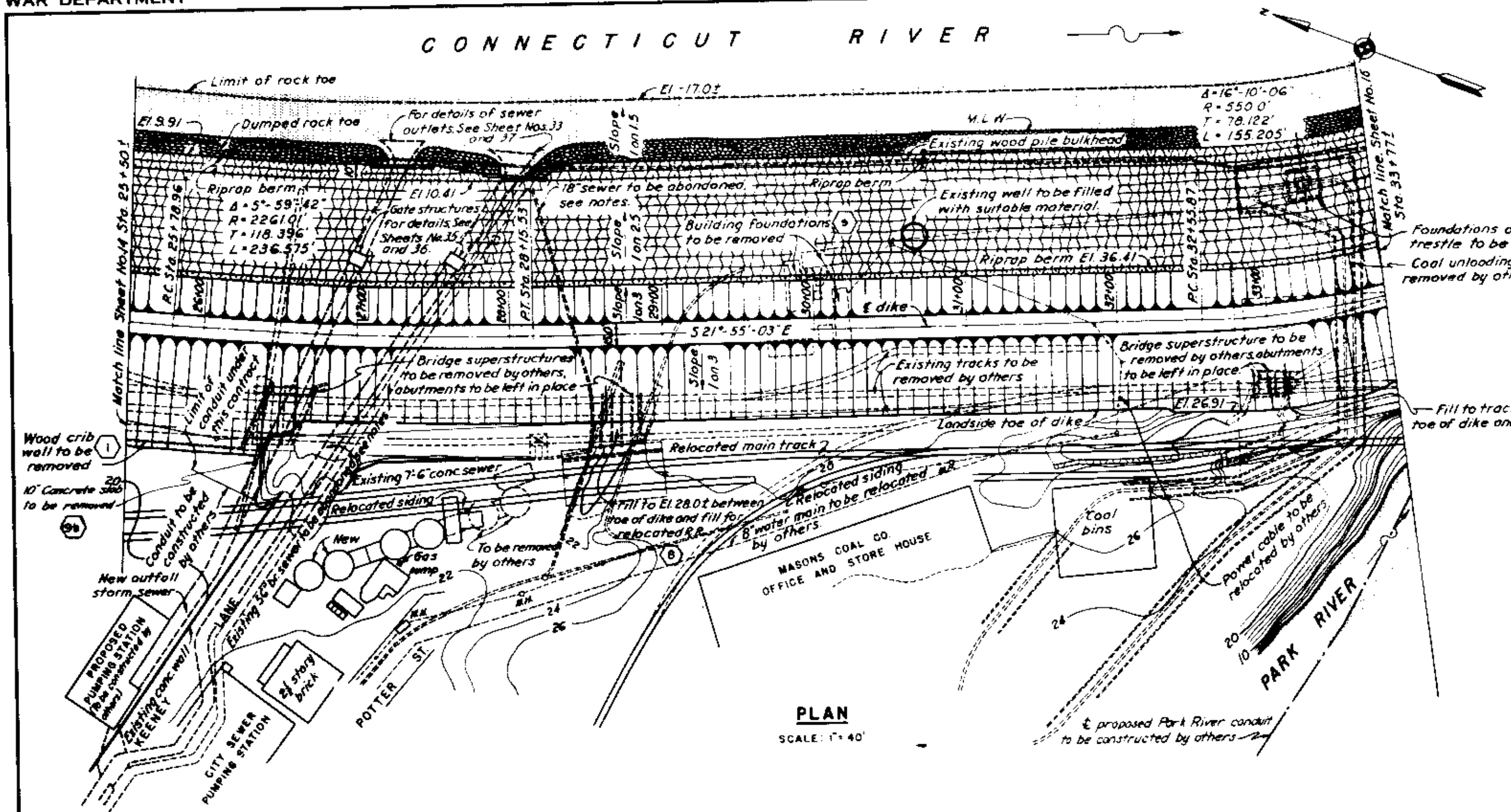
FILE NO. CT-4-2474

Ht. 5 87b

PLATE NO. 7

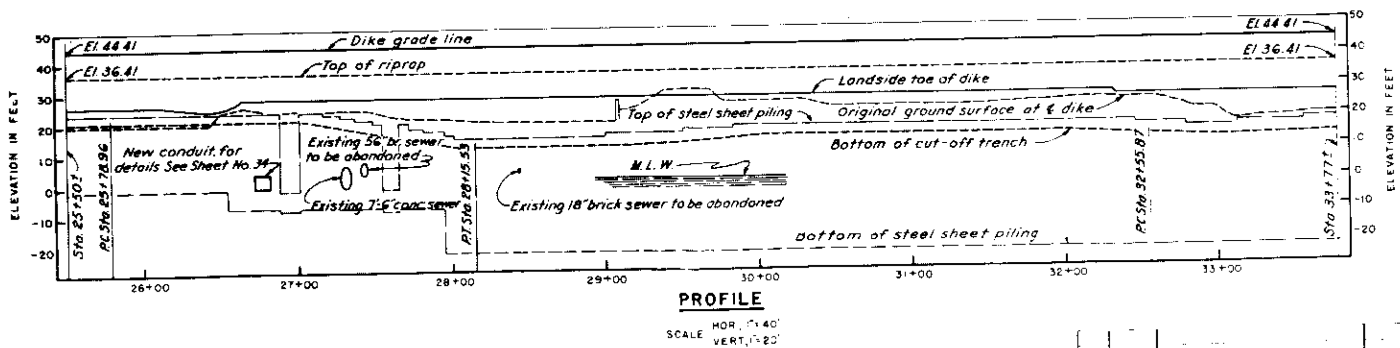
WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



STATION COORDINATES

STATION	NORTHINGS	EASTINGS
P.C. Sta. 25+78.96	N 50169.95	E 70842.42
P.T. Sta. 28+15.53	N 49946.25	E 70919.09
P.C. Sta. 32+55.87	N 49537.75	E 71083.46



NOTES

56" brick sewer, and 18" brick sewer to be filled with sand and plugged as directed by the contracting officer. (8)

For general notes applying to this sheet, see Sheet No. 12

KEY	DATE	REVISION Indicated by Δ	REV BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL
HARTFORD DIKE
RIVERFRONT, MORGAN ST TO STA 96+73
PLAN AND PROFILE NO 4

CONNECTICUT RIVER — CONNECTICUT
IN 128 SHEETS — SCALE 1 IN = 40 FT — SHEET NO 15

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., MAY 1940

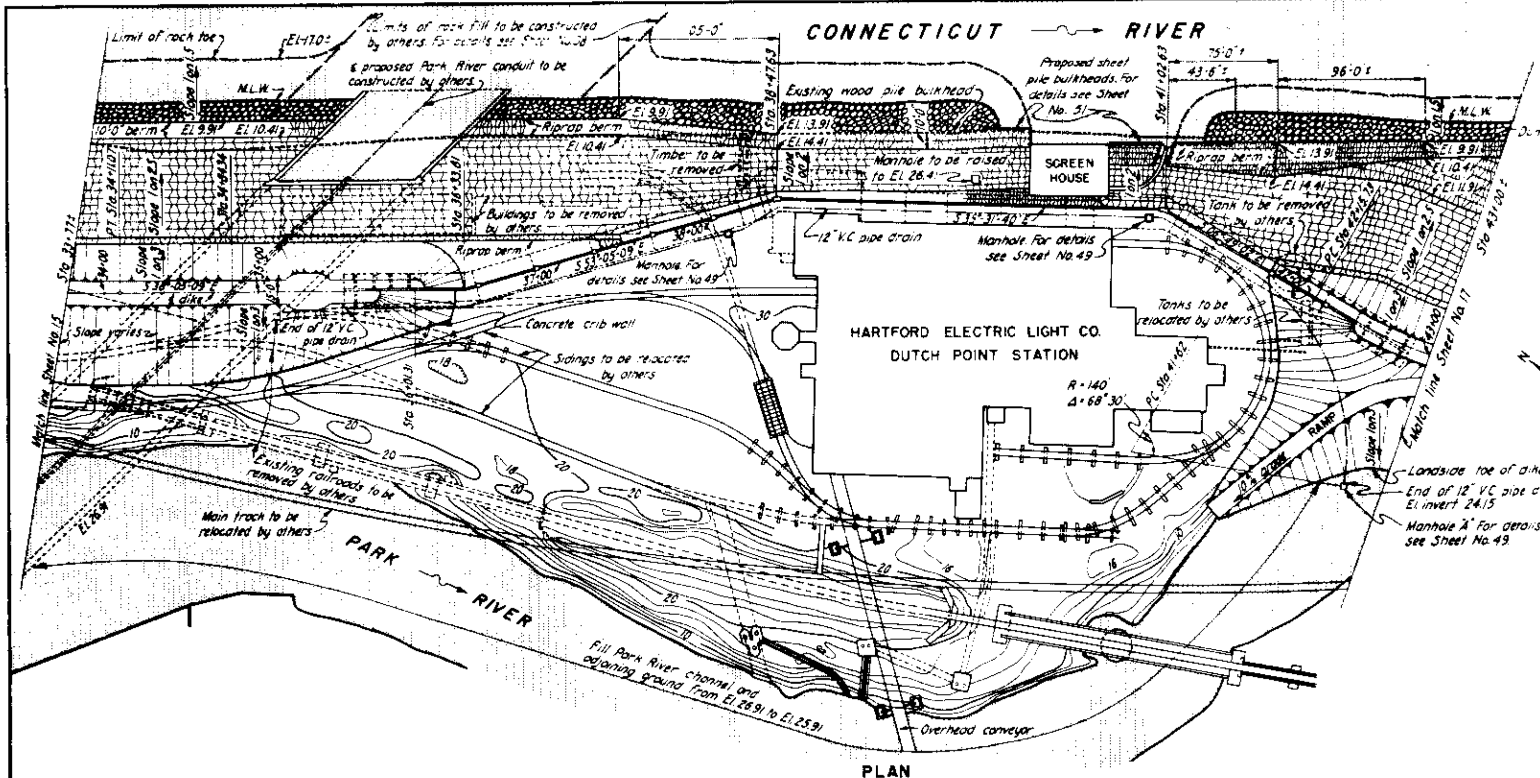
SUBMITTED: Senior Engineer, Head Design Section
APPROVAL RECOMMENDED: Principal Engineer, Chief, F.C. Engineering Div.
APPROVED: Lt. Col., Corps of Engineers, District Engineer
DESIGNED: Assoc. Engineer
DRAWN: J.W.C. TRACED: J.T. CHECKED: W.A.E.
FISCAL YEAR 1940
FILE NO. CT-4-2475

Ht. 5 8.7b

PLATE NO. 8

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY

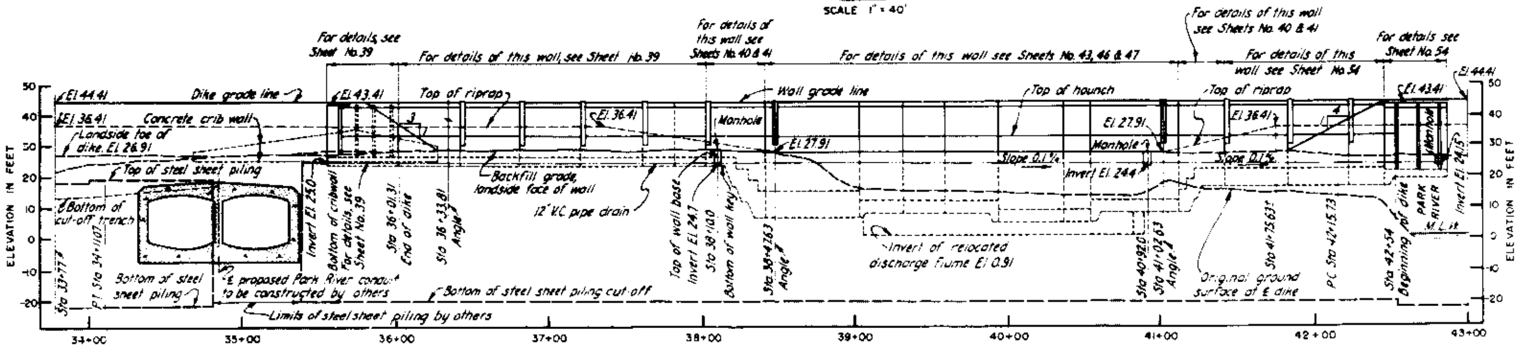


PLAN

SCALE 1" = 40'

For foundation and fill treatment in Park River see Sheets No. 52 & 53.

STATION COORDINATES		
STATION	NORTHINGS	EASTINGS
PT Sta. 34+11.07	N 49403.78	E 71160.81
Angle Sta. 36+33.81	N 49228.47	E 71298.20
Angle Sta. 38+47.63	N 49100.04	E 71469.16
Angle Sta. 41+02.63	N 48892.52	E 71617.34
PC Sta. 42+15.73	N 48780.22	E 71630.78



PROFILE

SCALES HOR. 1" = 40' VERT. 1" = 20'

NOTES

For general notes applying to this sheet see Sheet No. 12.

Alignment data refers to west face of proposed wall.

CONNECTICUT RIVER FLOOD CONTROL

HARTFORD DIKE

RIVERFRONT, MORGAN ST. TO STA. 96+73

PLAN AND PROFILE NO. 5

CONNECTICUT RIVER — CONNECTICUT

IN 128 SHEETS — SCALE: 1 IN. = 40 FT. — SHEET NO. 16

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., MAY 1940

SUBMITTED — APPROVAL RECOMMENDED — APPROVED

FISCAL YEAR 1940

FILE NO. CT-4-2476

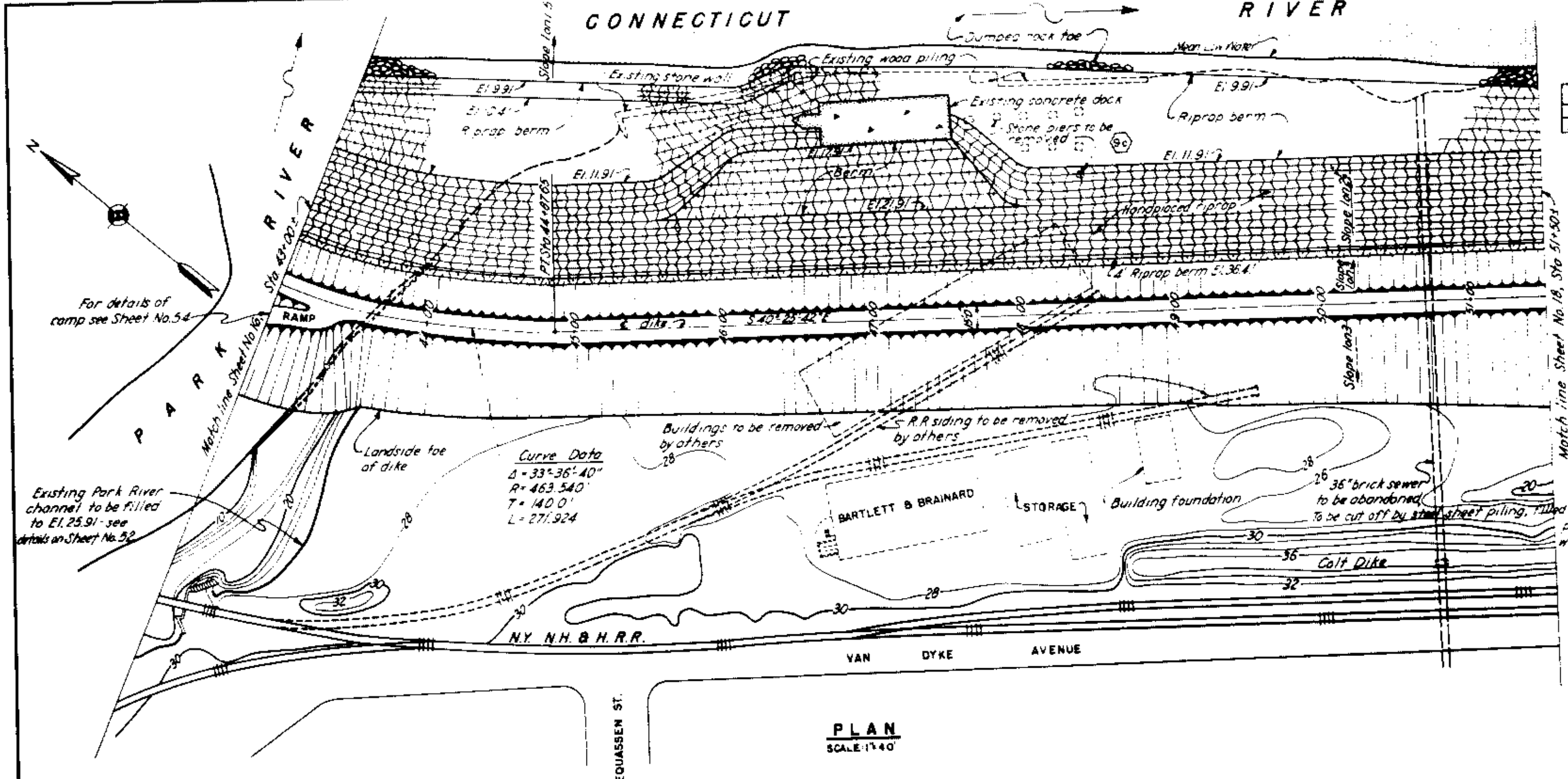
KEY	DATE	REVISION Indicated by Δ	REV. BY	CK. BY	AP. BY

PLATE NO. 9

Ht. 5 & 7b

WAR DEPARTMENT

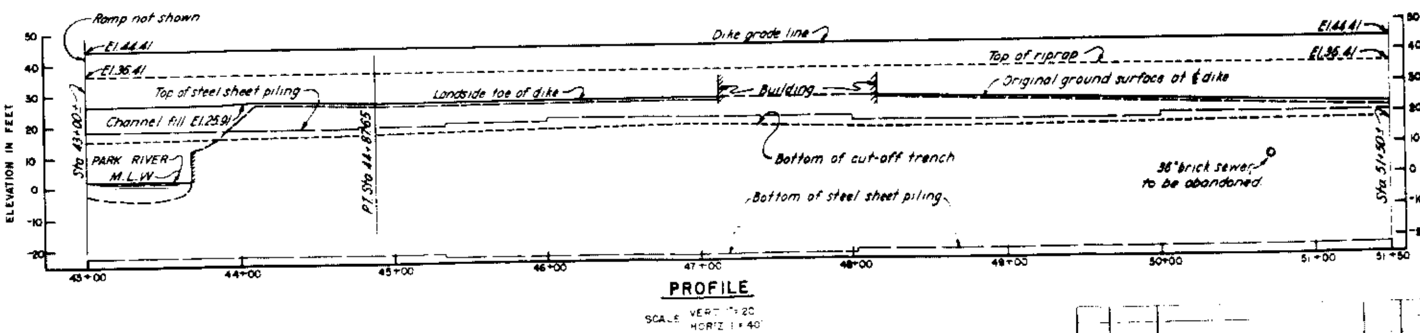
CORPS OF ENGINEERS, U. S. ARMY



PLAN
SCALE: 1"=40'

STATION COORDINATES

STATION	NORTHINGS	EASTINGS
PT Sta 44+87.65	N-48534.64	E-71738.17



PROFILE
SCALE: VERT. 1"=20' HORIZ. 1"=40'

NOTES

For general notes, see Sheet No. 12.
For details of Park River foundation treatment, see Sheets No. 52 and 53.

KEY	DATE	REVISION (indicated by Δ)	REV. BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL
HARTFORD DIKE
RIVERFRONT, MORGAN ST. TO STA. 96+73
PLAN AND PROFILE NO. 6

CONNECTICUT RIVER IN 128 SHEETS — SCALE: 1 IN. = 40 FT — CONNECTICUT SHEET NO. 19

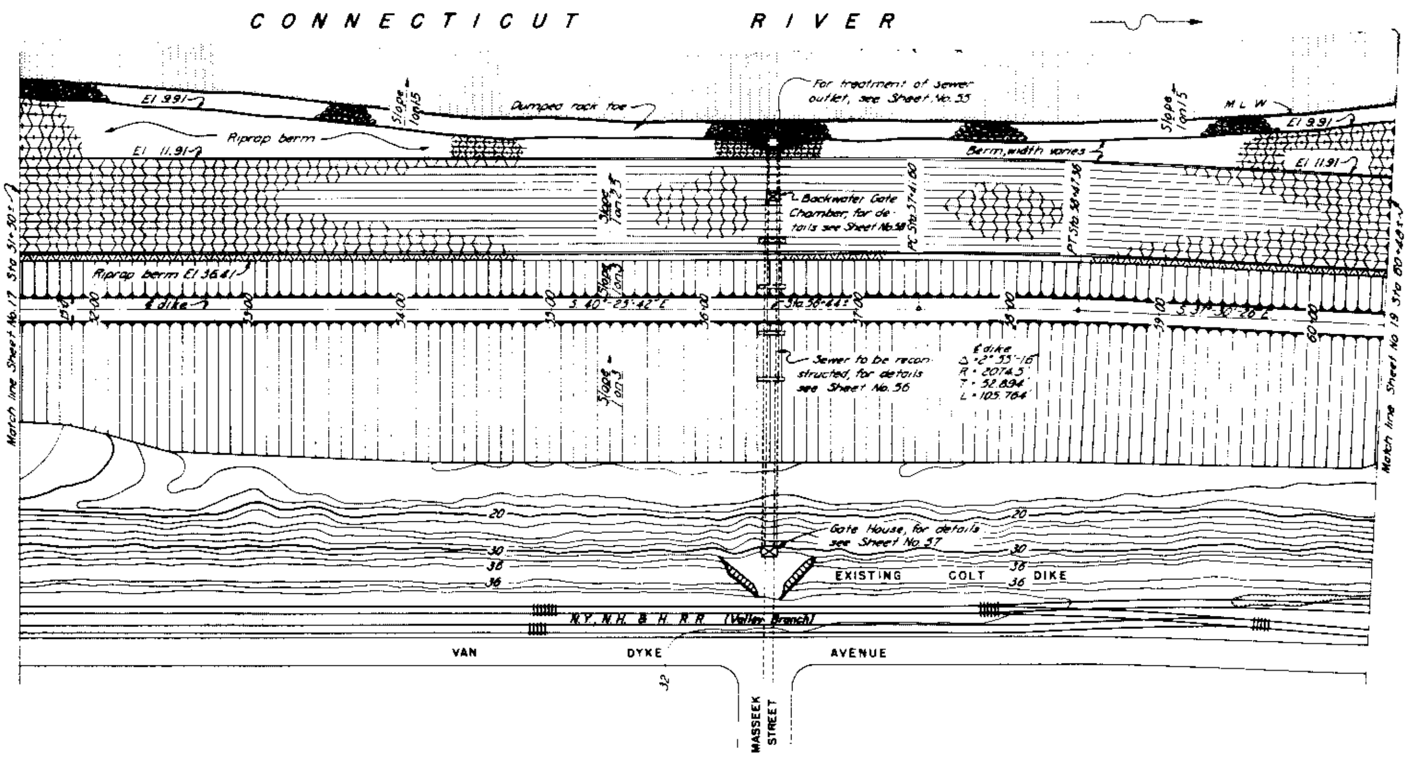
U.S. ENGINEER OFFICE, PROVIDENCE, R.I. — MAY 1940

H1.5 B 7b

PLATE NO. 10

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



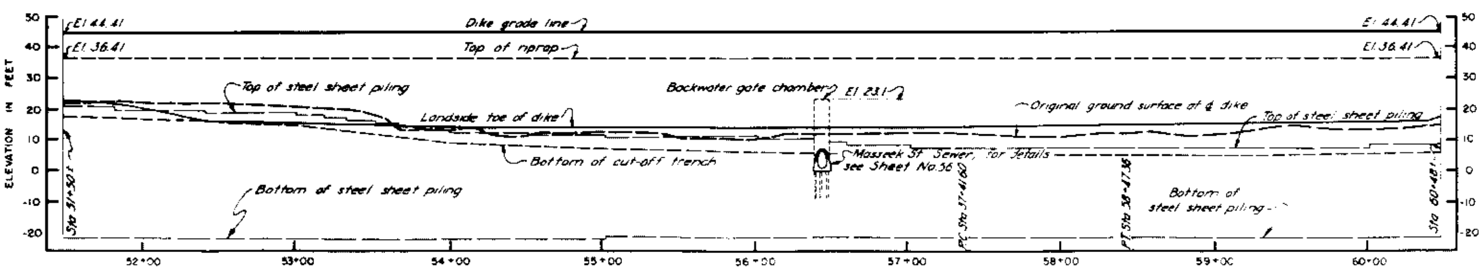
PLAN

SCALE 1" = 40'

STATION COORDINATES		
STATION	NORTHINGS	EASTINGS
P.C. 57+41.60	47580.11	72551.35
P.T. 58+47.36	47497.89	72617.86

NOTE

For general notes applying to this sheet see Sheet No. 12.



PROFILE

SCALE HOR. 1" = 40' VERT. 1" = 20'

KEY	DATE	REVISION Indicated by Δ	REV BY	CK BY	AP BY

CONNECTICUT RIVER FLOOD CONTROL

HARTFORD DIKE

RIVERFRONT, MORGAN ST TO STA 96+73

PLAN AND PROFILE NO. 7

CONNECTICUT RIVER — CONNECTICUT

IN 28 SHEETS — SCALE 1 IN = 40 FT. — SHEET NO. 18

U. S. ENGINEER OFFICE, PROVIDENCE, R.I., MAY 1940

SUBMITTED: SENIOR ENGINEER, HEAD DESIGN SECTION — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, F.C. ENGINEERING DIV. — APPROVED: LT. COL. CORPS OF ENGINEERS, DISTRICT ENGINEER

DESIGNED: SENIOR ENGINEER — DRAWN D.W.C. — TRACED L.V.P. — CHECKED W.A.C.

FISCAL YEAR 1940

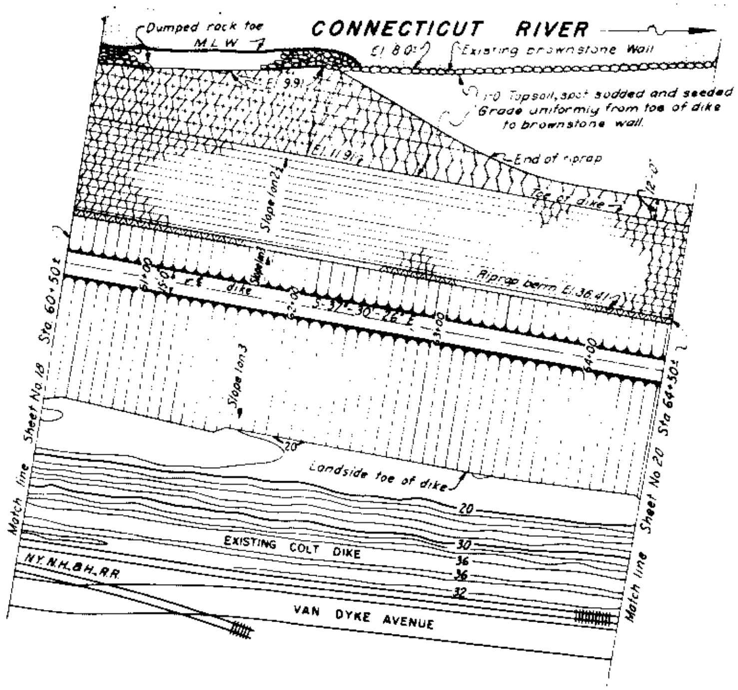
FILE NO. CT-4-2478

PLATE NO. 11

Ht. 5 87b

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY

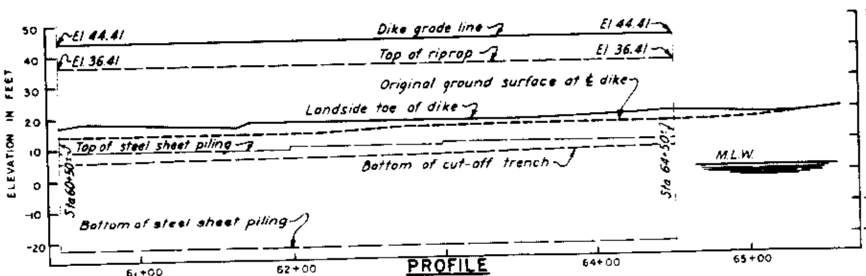


PLAN

SCALE: 1"=40'

NOTE

For general notes applying to this sheet see Sheet No. 12.



PROFILE

SCALE HOR. 1"=40' VERT. 1"=20'

KEY	DATE	REVISION Indicated by Δ	REV BY	CK BY	AP BY

CONNECTICUT RIVER FLOOD CONTROL
HARTFORD DIKE
RIVERFRONT, MORGAN ST TO STA 96+73
PLAN AND PROFILE NO. 8

CONNECTICUT RIVER IN 128 SHEETS — SCALE: 1 IN = 40 FT — CONNECTICUT SHEET NO. 19

U.S. ENGINEER OFFICE, PROVIDENCE, R.I. MAY 1940

SUBMITTED: SENIOR ENGINEER, HEAD, DESIGN SECTION — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, F.C. ENGINEERING DIV. — APPROVED: LT. COL. CORPS OF ENGINEERS, DISTRICT ENGINEER

DESIGNED: ASSOC. ENGINEER — DRAWN: D.W.C. — TRACED: C.M.A. — CHECKED: W.O.E.

FISCAL YEAR 1940

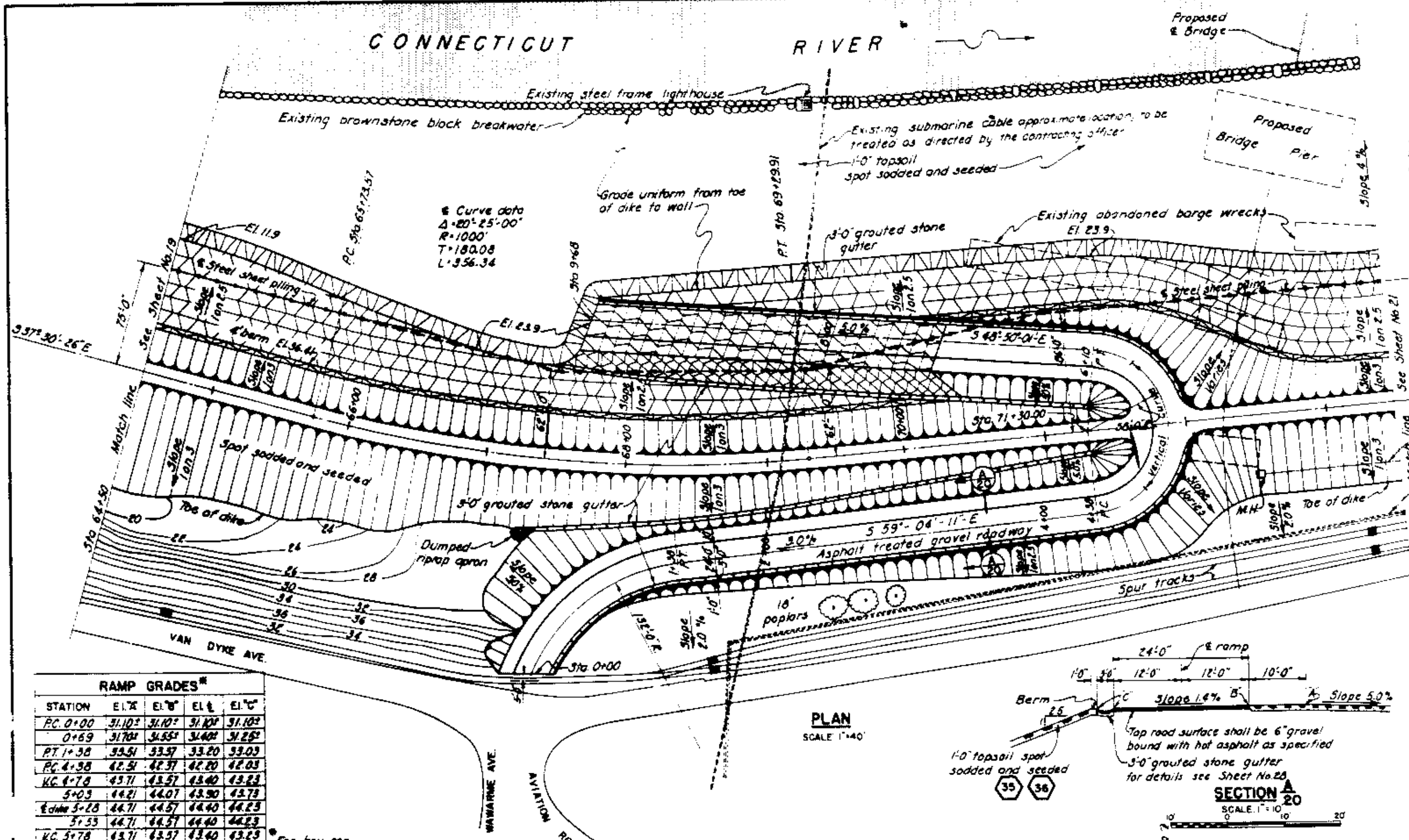
FILE NO. CT-4-2479

Ht. 587b

PLATE NO. 12

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



STATION	NORTHINGS	EASTINGS
P.C. Sta. 65+73.57	46921.80	73060.02
P.I.	46778.95	73169.66
P.T. Sta. 69+29.91	46683.32	73322.25

STATION COORDINATES

Stationing is on ℄ dike

Proposed Bridge and Viaduct piers to be constructed by others prior to or during dike construction

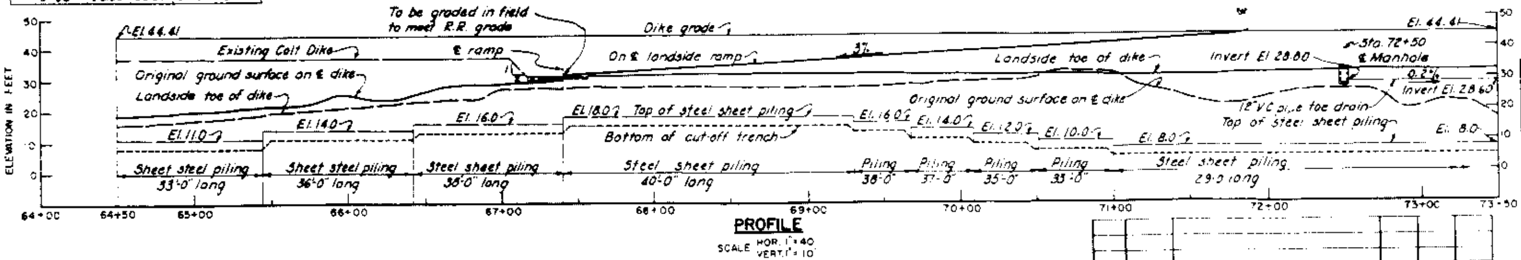
RAMP GRADES*

STATION	El. "A"	El. "B"	El. ℄	El. "C"
P.C. 0+00	31.10±	31.10±	31.10±	31.10±
0+69	31.70±	31.55±	31.40±	31.25±
P.T. 1+38	33.51	33.37	33.20	33.03
P.C. 4+38	42.51	42.37	42.20	42.03
V.C. 4+78	43.71	43.57	43.40	43.23
5+03	44.21	44.07	43.90	43.73
℄ dike 5+28	44.71	44.57	44.40	44.23
5+53	44.71	44.57	44.40	44.23
V.C. 5+78	43.71	43.57	43.40	43.23
P.T. 6+10	42.11	41.97	41.80	41.63
9+68	23.90	23.90	23.90	23.90

*For key see Section A/20

NOTES

For General Plan see Sheet No. 2
Elevations refer to Mean Sea Level Datum
For typical cross sections and toe drain details see Sheets No. 27 & 28.
For details of manholes see Sheet No. 68
For steel sheet piling layout see Sheets No. 83 & 84.
Figures in hexagons indicate item numbers under which payment shall be made.
All exposed edges of concrete shall be chamfered one inch, unless otherwise noted.
All stationing and ties are to ℄ dike or wall.
Any sewers, utilities etc., not shown on the drawing and within limits of proposed structure shall be treated as directed by the Contracting Officer
All concrete shall be Class "A" and payment will be made under item No. 24
All railroad removal and replacement to be performed by others.



KEY	DATE	REVISION Indicated by Δ	REV. BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL

HARTFORD DIKE

RIVERFRONT, MORGAN ST TO STA. 96+73

PLAN AND PROFILE NO. 9

CONNECTICUT RIVER IN 128 SHEETS — SCALE 1 IN=40 FT — CONNECTICUT SHEET NO 20

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., MAY 1940

SUBMITTED: SENIOR ENGINEER, HEAD, DESIGN SECTION — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, F.C. ENGINEERING DIV — APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

DESIGNED: ASSOC. ENGINEER — DRAWN: R.H.S. TRACED: H.R. CHECKED: W.O.S.

FISCAL YEAR 1940

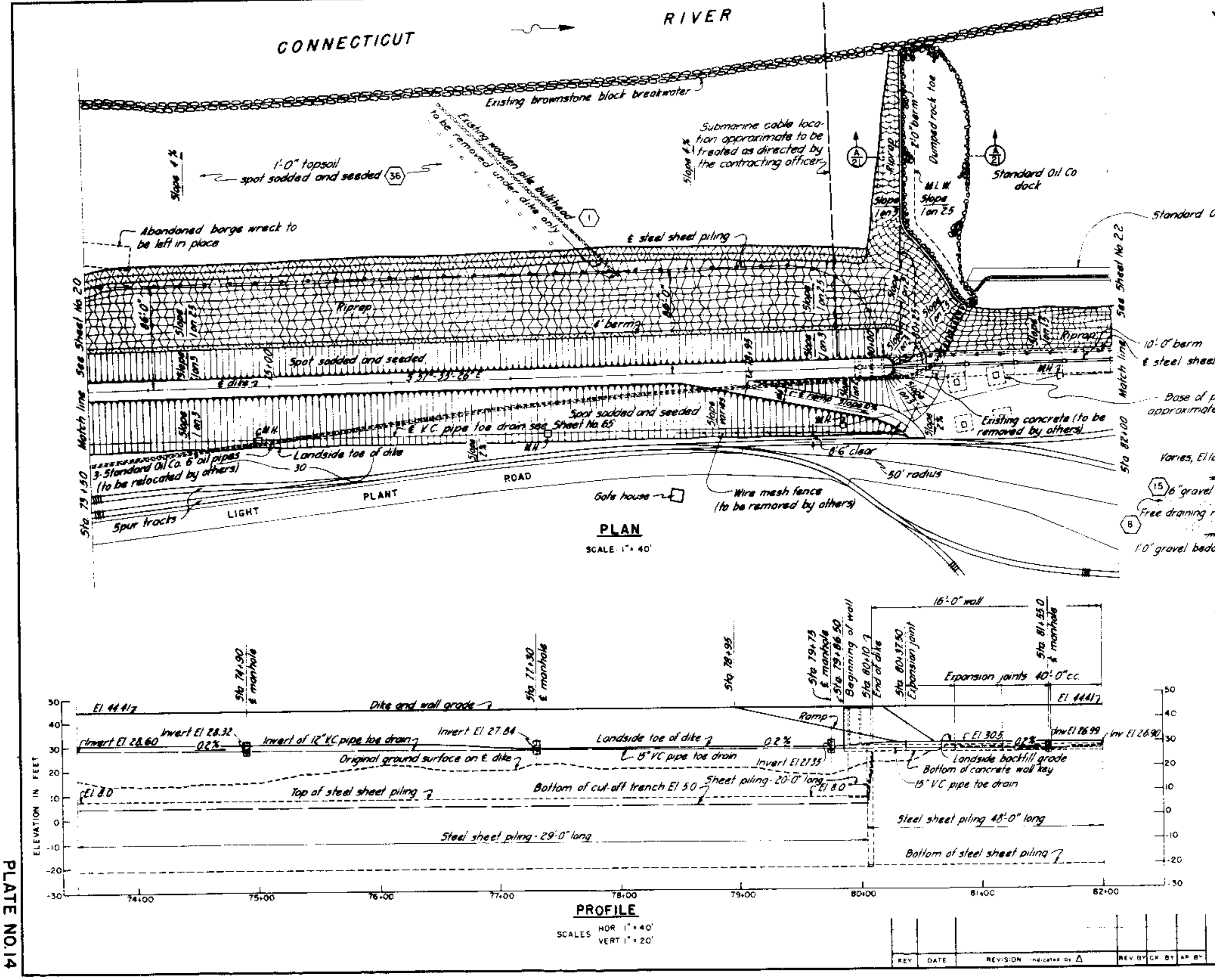
FILE NO. CT-4-2480

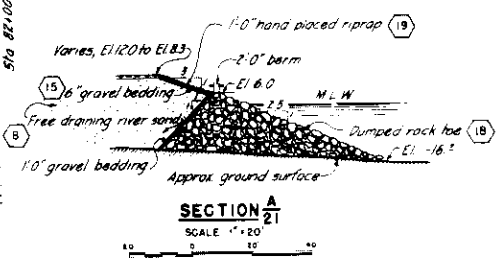
Ht. 5 B 7b

PLATE NO. 13

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY





NOTES

For general notes applying to this sheet see Sheet No. 20.

For details of dike-wall connection see Sheet No. 59.

For detail of ramp see Sheet No. 59.

CONNECTICUT RIVER FLOOD CONTROL
HARTFORD DIKE
RIVERFRONT, MORGAN ST. TO STA. 96+73
PLAN AND PROFILE NO. 10

CONNECTICUT RIVER — CONNECTICUT
IN 128 SHEETS — SCALE: 1 IN = 40 FT — SHEET NO. 21

U. S. ENGINEER OFFICE, PROVIDENCE, R.I. — MAY 1940

FISCAL YEAR 1940
FILE NO. CT-4-2481

Ht. 5 & 7b

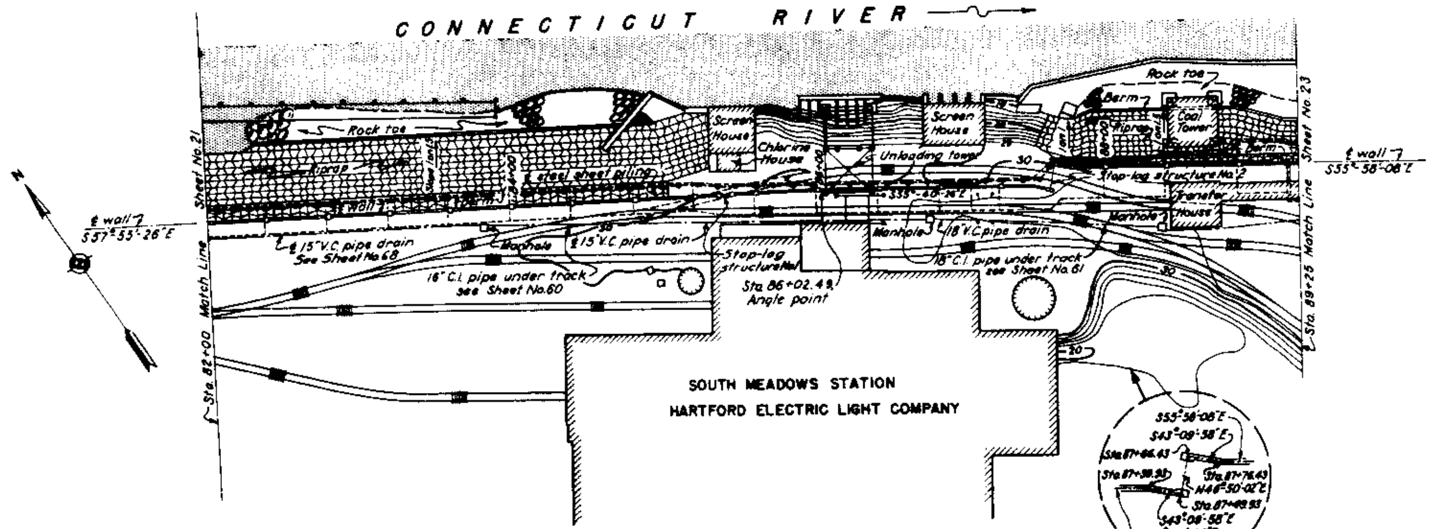
PLATE NO. 14

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY

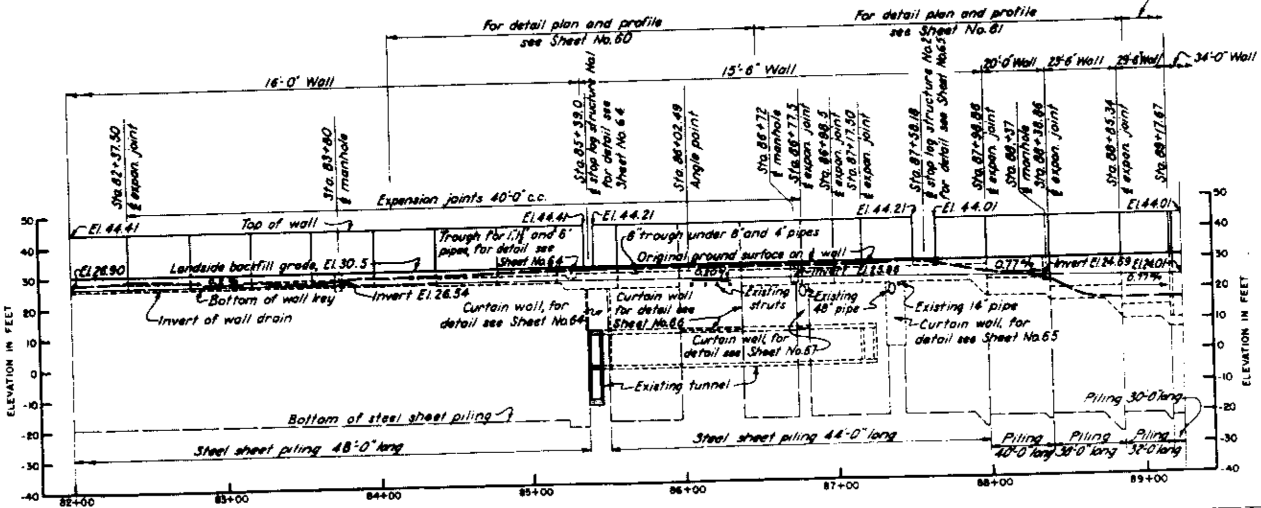
STATION COORDINATES		
STATION	NORTHINGS	EASTINGS
∠ Sta. 86+02.49	N-45785.10	E-74739.50
∠ Sta. 87+39.93	N-45717.60	E-74853.0
∠ Sta. 87+49.93	N-45710.31	E-74859.84
∠ Sta. 87+66.43	N-45721.80	E-74871.88
∠ Sta. 87+76.43	N-45714.30	E-74878.72

Stationing is to ℄ wall.



PLAN

SCALE: 1" = 40'



PROFILE

SCALE: HOR. 1" = 40' VERT. 1" = 20'

NOTES

For general notes applying to this sheet see Sheet No 20

KEY	DATE	REVISION (Indicated by Δ)	REV. BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL

HARTFORD DIKE

RIVERFRONT, MORGAN ST TO STA 96+73

PLAN AND PROFILE NO. 11

CONNECTICUT RIVER IN 128 SHEETS — SCALE: 1 IN. = 40 FT. — CONNECTICUT SHEET NO. 22

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., MAY 1940

SUBMITTED: / APPROVAL RECOMMENDED: / APPROVED:

FISCAL YEAR 1940

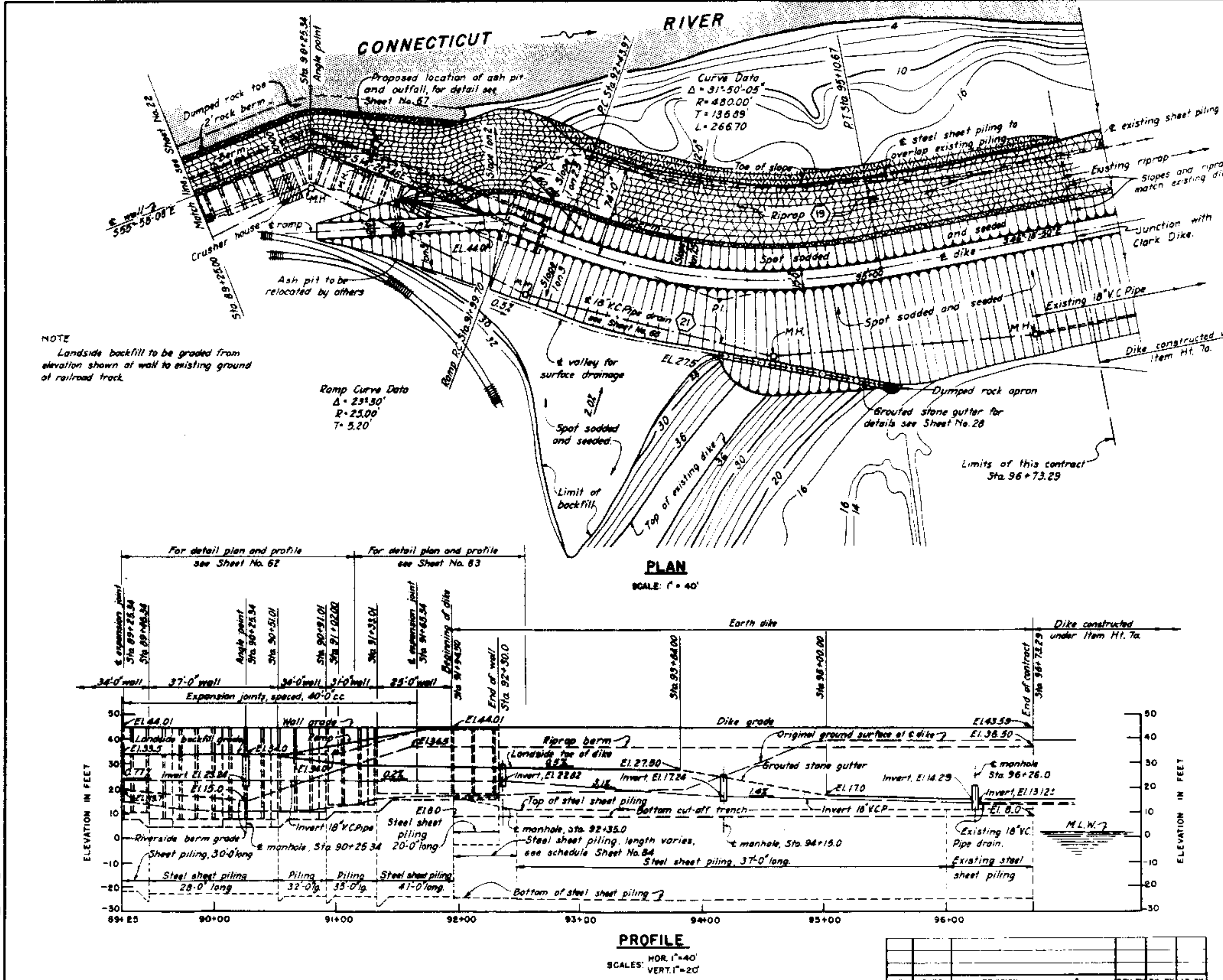
FILE NO. CT-4-2482

Ht. 587b

PLATE NO. 15

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



STATION COORDINATES		
STATION	NORTHINGS	EASTINGS
∠ Sta 90+25.34	N-45575.00	E-75085.00
PC Sta 92+43.97	N-45363.32	E-75139.66
PI	N-45230.78	E-75173.89
PT Sta 95+10.67	N-45136.23	E-75272.88
End Sta 96+73.29	N-45023.90	E-75390.48

NOTES

For general notes applying to this sheet see Sheet No. 20.
For dike-wall connection details see Sheet No. 63.
For Detail Plan and Profile see Sheet No. 62.
For detail of top of ramp, see Sheet No. 26.

KEY	DATE	REVISION (indicated by Δ)	REV. BY	CK. BY	AP. BY

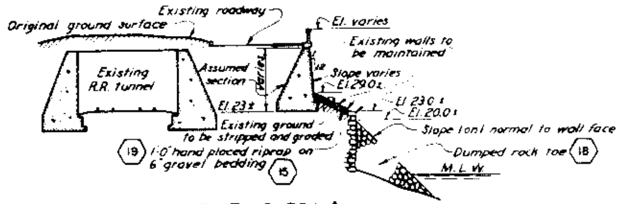
CONNECTICUT RIVER FLOOD CONTROL
HARTFORD DIKE
RIVERFRONT, MORGAN ST. TO STA. 96+73.
PLAN AND PROFILE NO. 12
CONNECTICUT RIVER — CONNECTICUT
IN 128 SHEETS — SCALE: 1 IN = 40 FT — SHEET NO. 23
U.S. ENGINEER OFFICE, PROVIDENCE, R.I., MAY 1940
SUBMITTED: SENIOR ENGINEER, HEAD, DESIGN SECTION — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, F.C. ENGINEERING DIV. — APPROVED: LT. COL. CORPS OF ENGINEERS, DISTRICT ENGINEER
DESIGNED: — DRAWN: F.F.C.B.D.L.B — TRACED: P.J.B — CHECKED: W.O.C.
FISCAL YEAR 1940
FILE NO. CT-4-2483

Ht. 5 87b

PLATE NO. 16

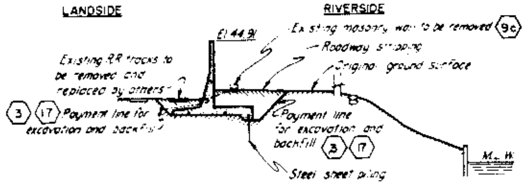
WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



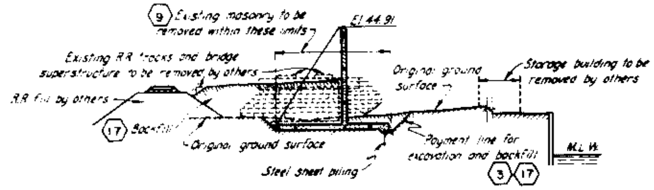
SECTION AT STA. 0+50± △

SCALE: 1" = 20'



SECTION AT STA. 8+50

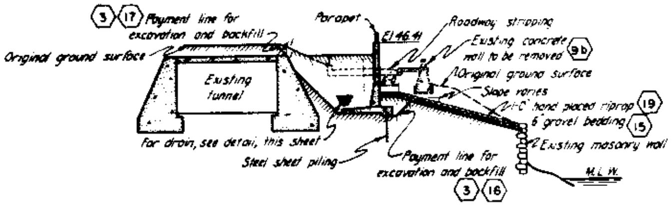
SCALE: 1" = 20'



SECTION AT STA. 19+80

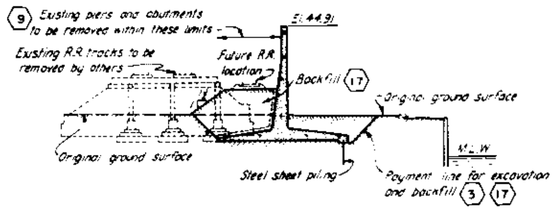
(GROVE STREET OVERPASS)

SCALE: 1" = 20'



SECTION AT STA. 2+00

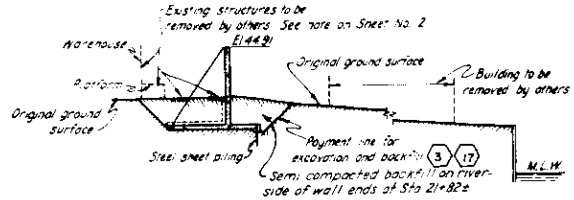
SCALE: 1" = 20'



SECTION AT STA. 16+00

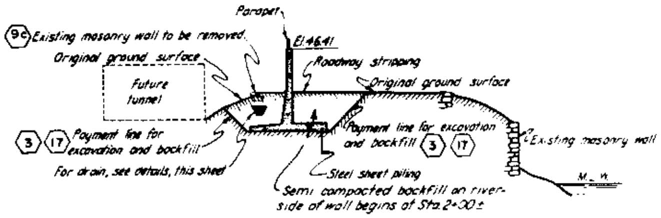
(STATE STREET OVERPASS)

SCALE: 1" = 20'



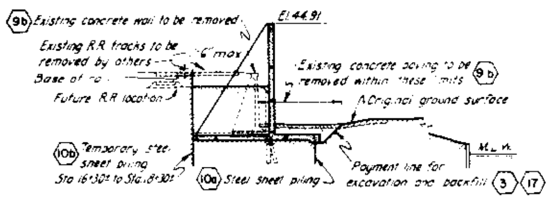
SECTION AT STA. 21+00

SCALE: 1" = 20'



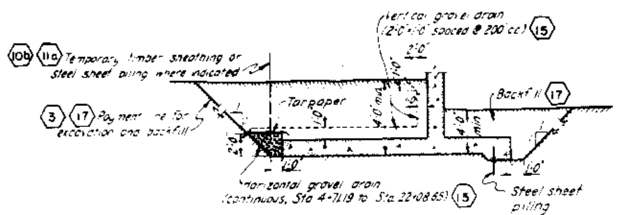
SECTION AT STA. 4+00

SCALE: 1" = 20



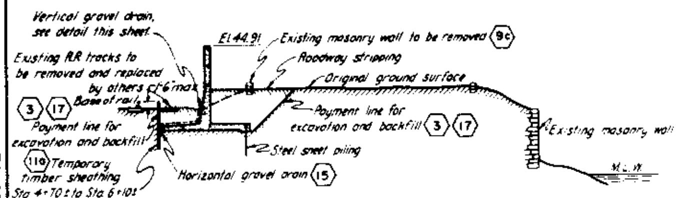
SECTION AT STA. 18+00

SCALE: 1" = 20



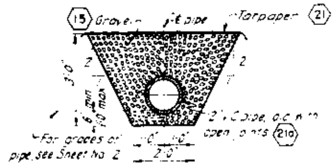
TYPICAL EXCAVATION AND DRAIN TREATMENT

SCALE: 3/16" = 1'-0"



SECTION AT STA. 4+75

SCALE: 1" = 20'



DETAIL OF GRAVEL DRAIN

△ STA. 0+70± TO STA. 4+50

SCALE: 1/2" = 1'-0"

NOTES

Elevations refer to Mean Sea Level Datum.

Figures in hexagons indicate item numbers under which payment will be made.

For details of steel sheet piling, see Sheets No. 77 & 78.

For details of concrete walls, see Sheets No. 70 to 73 incl.

For general plan, see Sheets No. 2, 3 and 4.

KEY	DATE	REVISION	REV. BY	CK. BY	AP. BY
△		Cross section & drain sta. changes			

CONNECTICUT RIVER FLOOD CONTROL

HARTFORD DIKE

RIVERFRONT, MORGAN ST. TO STA. 96+73

TYPICAL CROSS SECTIONS NO. 1

CONNECTICUT RIVER — CONNECTICUT

IN 128 SHEETS — SCALE 1 IN. = 20 FT. — SHEET NO. 24

U.S. ENGINEER OFFICE, PROVIDENCE, R.I. — MAY 1940

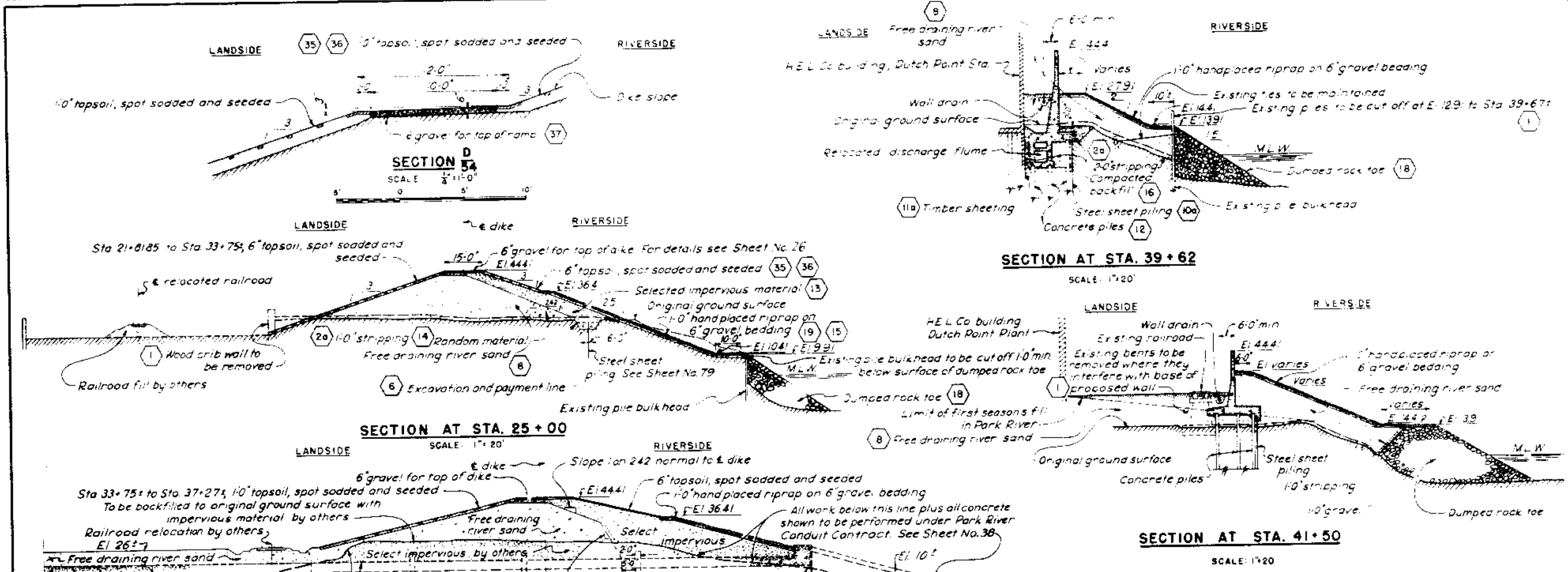
SUBMITTED: SENIOR ENGINEER, HEAD, DESIGN SECTION — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, F.C. ENGINEERING DIV. — APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

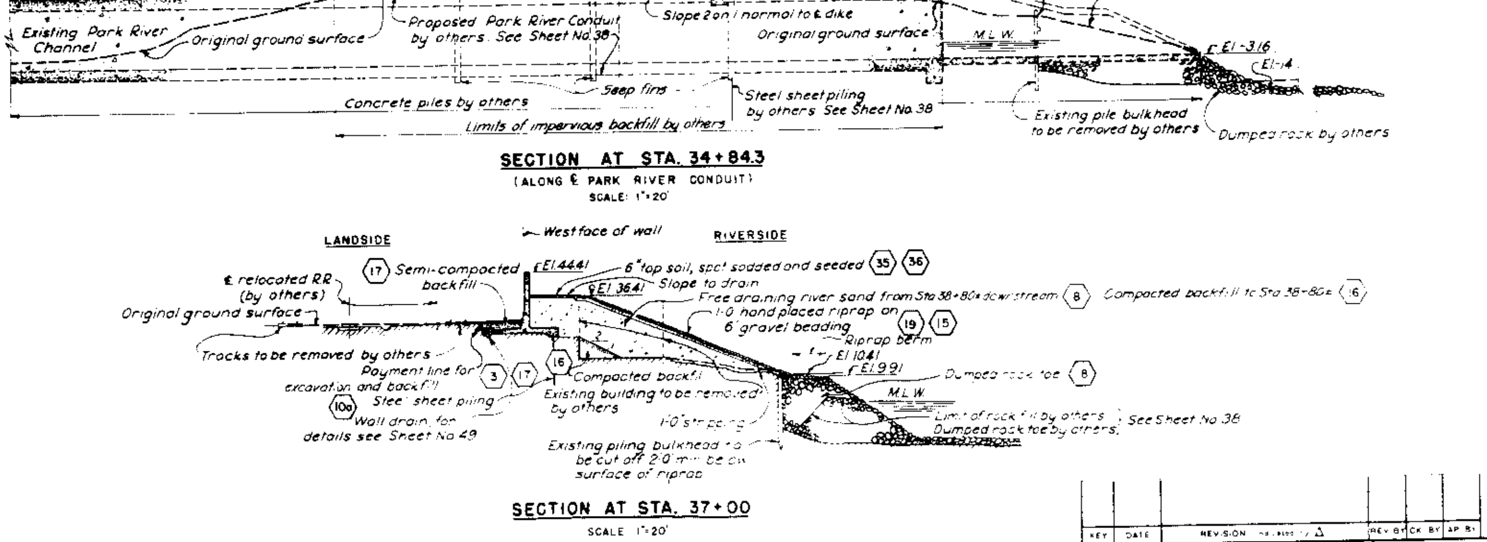
DESIGNED — DRAWN — TRACED — CHECKED — FISCAL YEAR 1940

PLATE NO. 17

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY





NOTES

Elevations refer to Mean Sea Level Datum.

Figures in hexagons indicate item numbers under which payment will be made.

For details of steel sheet piling see Sheets No. 79 and 80.

For details of concrete walls see Sheets No. 39, 40, 41, 46, 47, 54.

KEY	DATE	REVISION		REV. BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL

HARTFORD DIKE

RIVERFRONT, MORGAN ST. TO STA. 96+73

TYPICAL CROSS-SECTIONS NO. 2

CONNECTICUT RIVER — IN 125 SHEETS — SCALE 1" = 20 FT.

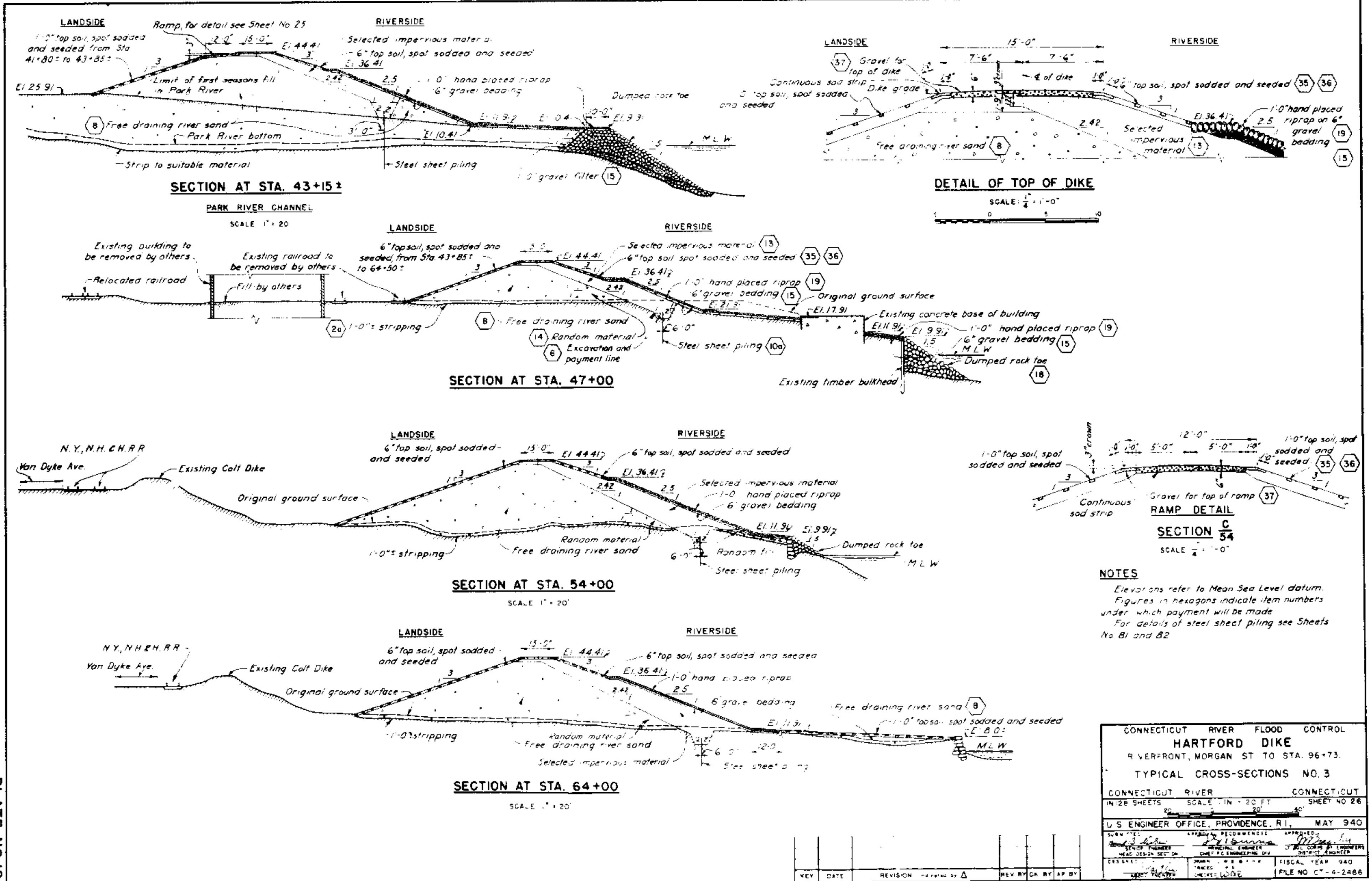
U.S. ENGINEER OFFICE, PROVIDENCE, R.I., MAY 1940

SUBMITTED — SENIOR ENGINEER, HEAD DESIGN SECTION; APPROVAL RECOMMENDED — PRINCIPAL ENGINEER, CHIEF, ENGINEERING DIV.; APPROVED — CORPS OF ENGINEERS, DISTRICT ENGINEER

FISCAL YEAR 1940 — FILE NO. CT-4 2485

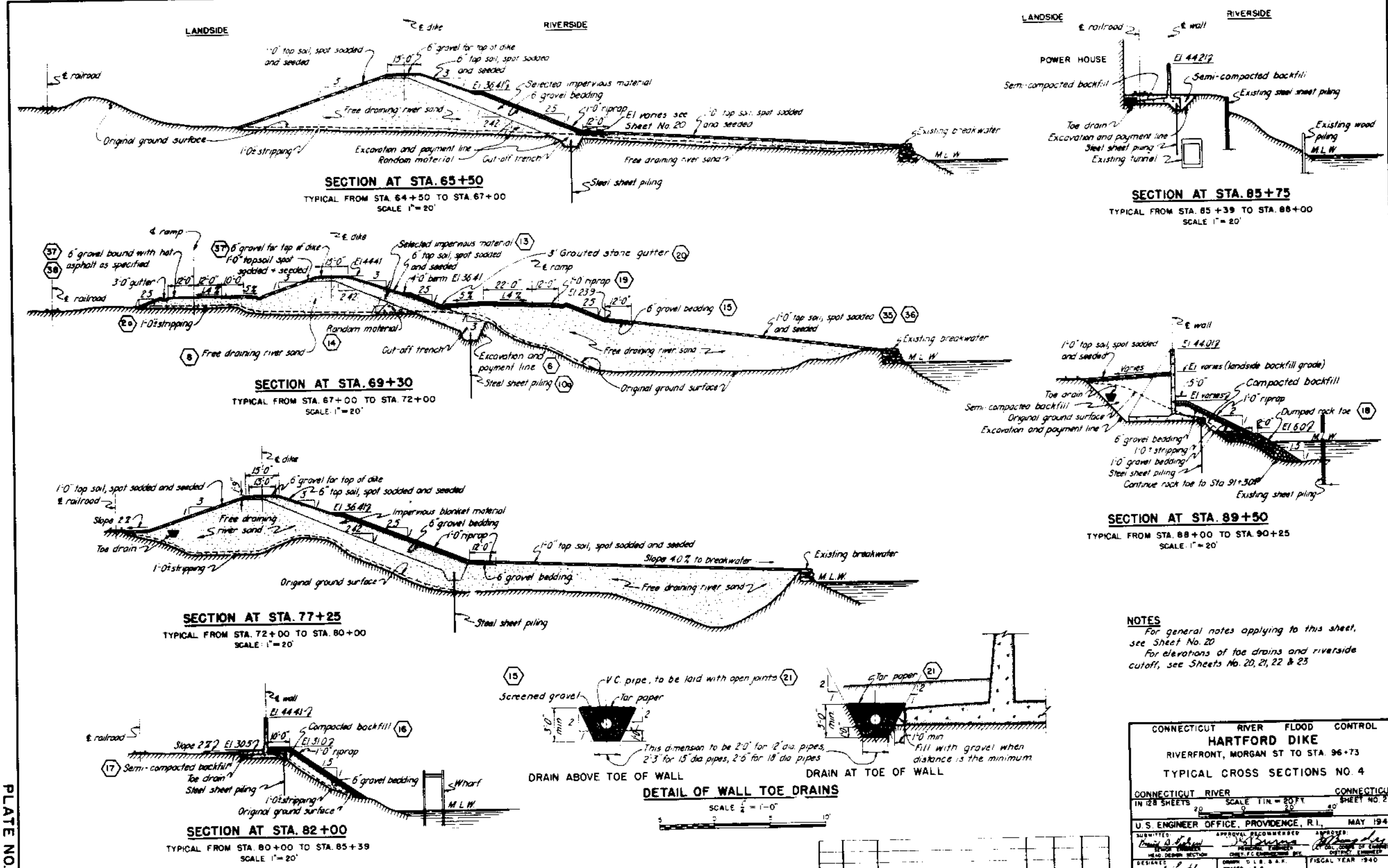
H1 5875

PLATE NO. 18


LANDSIDE
Ramp, for detail see Sheet No 25
RIVERSIDE
1'-0" top soil, spot sodded and seeded from Sta 41+80± to 43+85±
Selected impervious material
6" top soil, spot sodded and seeded
El. 44.41
El. 36.41
El. 25.91
Limit of first seasons fill in Park River
1'-0" hand placed riprap 6" gravel bedding
Dumped rock toe
Free draining river sand 8
Park River bottom
El. 10.41
El. 9.91
M L W
Strip to suitable material
Steel sheet piling
1'-0" gravel filter 15
SECTION AT STA. 43+15±
PARK RIVER CHANNEL
SCALE 1" = 20'
DETAIL OF TOP OF DIKE
SCALE: 1/4" = 1'-0"
LANDSIDE
RIVERSIDE
15'-0"
7'-6"
7'-6"
℄ of dike
37 Gravel for top of dike
Dike grade
Continuous sod strip
6" top soil, spot sodded and seeded
6" top soil, spot sodded and seeded 35 36
El. 36.41
1'-0" hand placed riprap on 6" gravel bedding 19 15
Free draining river sand 8
Selected impervious material 13
LANDSIDE
RIVERSIDE
Existing building to be removed by others
Existing railroad to be removed by others
Relocated railroad
Fill by others
6" topsoil, spot sodded and seeded, from Sta. 43+85± to 64+50±
Selected impervious material 13
6" top soil spot sodded and seeded 35 36
El. 44.41
El. 36.41
1'-0" hand placed riprap 19
6" gravel bedding 15
Original ground surface
El. 17.91
Existing concrete base of building
El. 11.91
El. 9.91
1'-0" hand placed riprap 19
6" gravel bedding 15
M L W
Dumped rock toe 18
2a 1'-0"± stripping
8 Free draining river sand
14 Random material
6 Excavation and payment line
Steel sheet piling 10a
Existing timber bulkhead
SECTION AT STA. 47+00
LANDSIDE
RIVERSIDE
N.Y., N.H. & H. R.R.
Van Dyke Ave.
Existing Colt Dike
Original ground surface
6" top soil, spot sodded and seeded
6" top soil, spot sodded and seeded
El. 44.41
El. 36.41
Selected impervious material
1'-0" hand placed riprap
6" gravel bedding
El. 11.91
El. 9.91
Dumped rock toe
M L W
Random material
1'-0"± stripping
Free draining river sand
Random fill
Steel sheet piling
SECTION AT STA. 54+00
SCALE 1" = 20'
RAMP DETAIL
SECTION C/54
SCALE 1/4" = 1'-0"
1'-0" top soil, spot sodded and seeded
1'-0" top soil, spot sodded and seeded 35 36
Continuous sod strip
Gravel for top of ramp 37
NOTES
Elevations refer to Mean Sea Level datum.
Figures in hexagons indicate item numbers under which payment will be made
For details of steel sheet piling see Sheets No 81 and 82
LANDSIDE
RIVERSIDE
N.Y., N.H. & H. R.R.
Van Dyke Ave.
Existing Colt Dike
Original ground surface
6" top soil, spot sodded and seeded
El. 44.41
6" top soil, spot sodded and seeded
El. 36.41
1'-0" hand placed riprap
6" gravel bedding
Free draining river sand 8
1'-0" top soil spot sodded and seeded
El. 8.0±
M L W
1'-0"± stripping
Random material
Free draining river sand
Selected impervious material
Steel sheet piling
SECTION AT STA. 64+00
SCALE 1" = 20'
KEY | DATE | REVISION | REV BY | CK BY | AP BY
CONNECTICUT RIVER FLOOD CONTROL
HARTFORD DIKE
RIVERFRONT, MORGAN ST TO STA. 96+73.
TYPICAL CROSS-SECTIONS NO. 3
CONNECTICUT RIVER
CONNECTICUT
IN 128 SHEETS
SCALE 1 IN = 20 FT
SHEET NO 26
U S ENGINEER OFFICE, PROVIDENCE, R.I.
MAY 1940
FISCAL YEAR 1940
FILE NO CT-4-2486

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



NOTES

For general notes applying to this sheet, see Sheet No. 20

For elevations of toe drains and riverside cutoff, see Sheets No. 20, 21, 22 & 23

KEY	DATE	REVISION · Indicated by Δ	REV BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL

HARTFORD DIKE

RIVERFRONT, MORGAN ST TO STA. 96+73

TYPICAL CROSS SECTIONS NO. 4

CONNECTICUT RIVER IN 128 SHEETS — SCALE 1 IN. = 20 FT. — CONNECTICUT SHEET NO. 27

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., MAY 1940

FISCAL YEAR 1940

FILE NO. CT-4-2487

Ht. 5 87b

PLATE NO. 20

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY

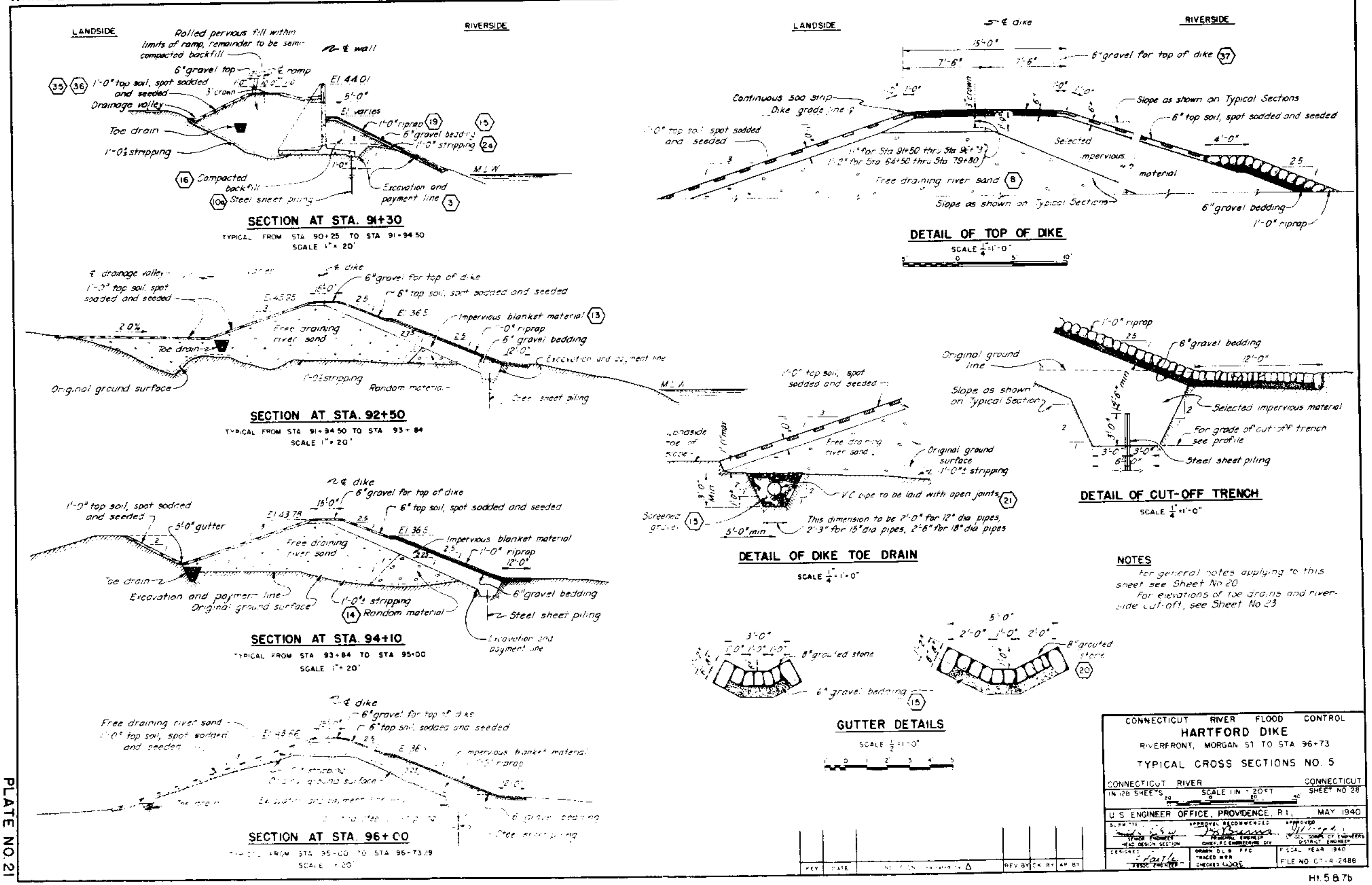
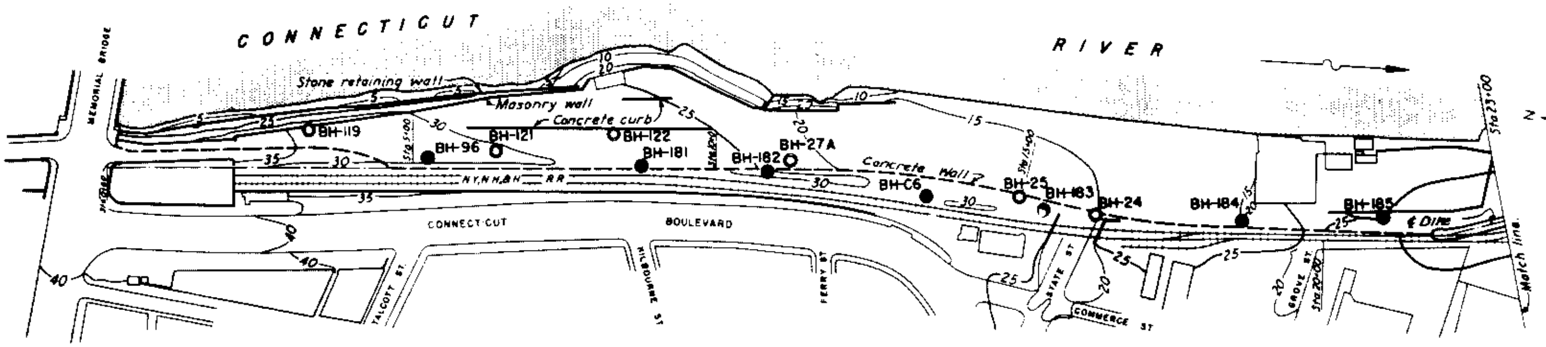


PLATE NO. 21

H1.5 8.7b

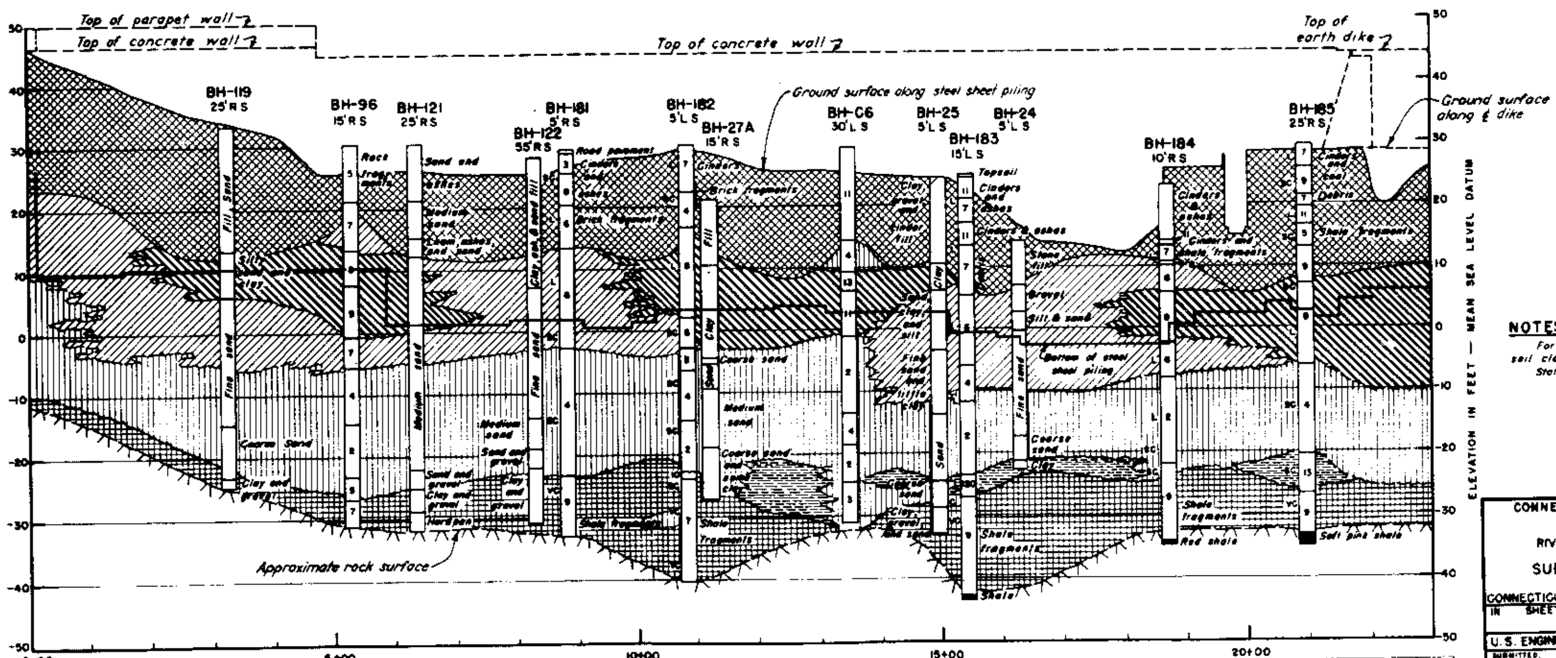
WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



PLAN

SCALE 1" = 100'



PROFILE ALONG SHEET PILING

SCALE HOR. 1" = 100' VERT. 1" = 10'

NOTES

For general notes, legend, and description of soil classes see Plate No. 24.
Stations and offsets refer to ℄ dike.

KEY	DATE	REVISION (indicated by Δ)	REV. BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL

HARTFORD DIKE

RIVERFRONT, MORGAN ST. TO STA 96+73

SUBSURFACE EXPLORATIONS NO. 1

CONNECTICUT RIVER — CONNECTICUT

IN SHEETS — SCALE 1 IN. = 100 FT — SHEET NO.

U. S. ENGINEER OFFICE, PROVIDENCE, R.I. — MAY 1940

SUBMITTED: SENIOR GEOLOGIST, HEAD GEOLOGY SECTION — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, F.C. ENGINEERING DIV. — APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

COMPILED: ASST. ENGINEER — DRAWN: R.R.L. & H.C.L. — TRACED: C.P.A. — CHECKED

FISCAL YEAR 1940

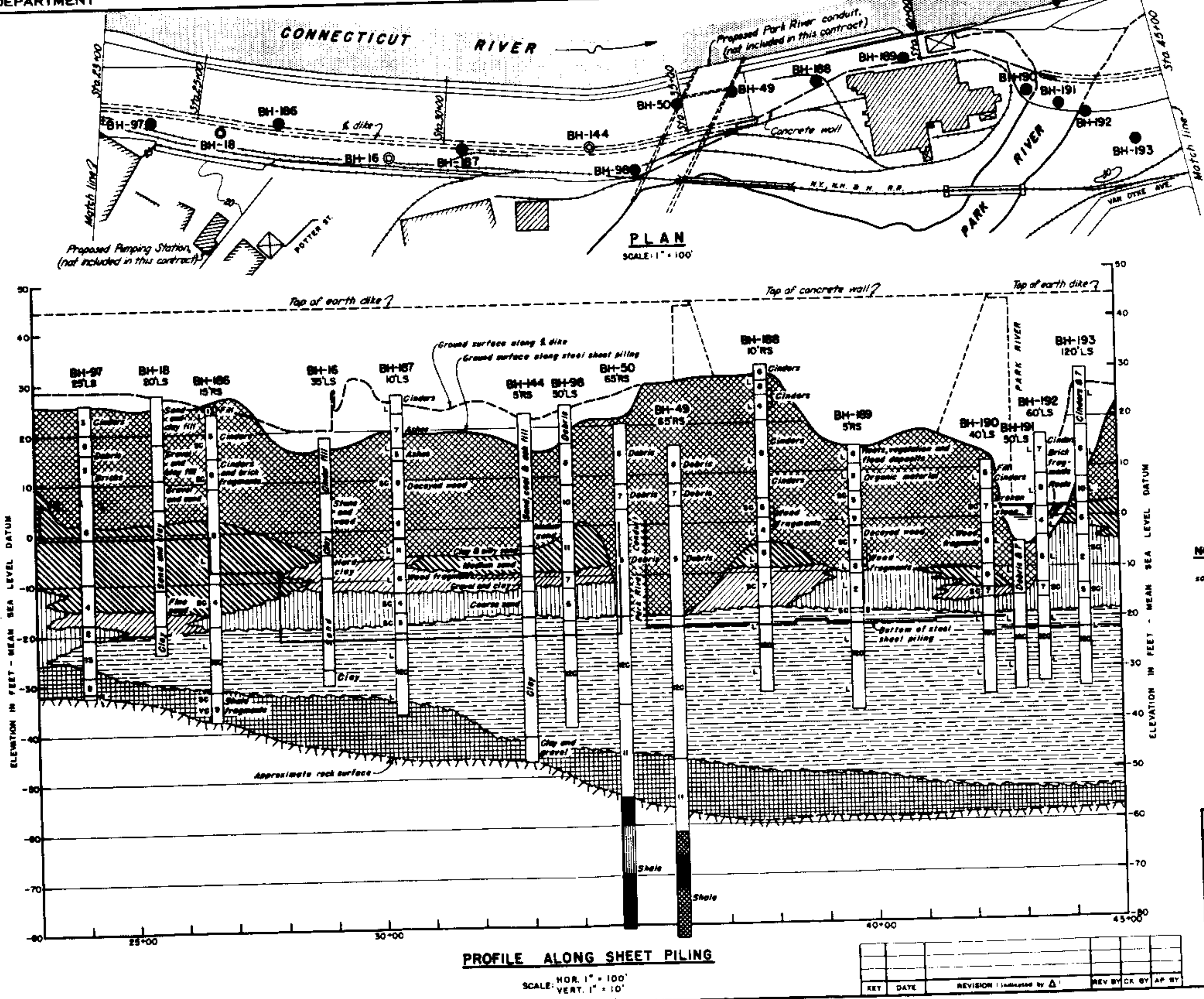
FILE NO. CT-2-1290

A. of D. — Ht. 5 & 7b

PLATE NO. 22

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



NOTES

For general notes, legend and description of soil classes, see Plate No. 24.

Stations and offsets refer to ℄ dike.

CONNECTICUT RIVER FLOOD CONTROL

HARTFORD DIKE

RIVERFRONT, MORGAN ST TO STA 96+73

SUBSURFACE EXPLORATIONS NO. 2

CONNECTICUT RIVER — CONNECTICUT

IN SHEETS — SCALE 1 IN. = 100 FT. — SHEET NO.

U. S. ENGINEER OFFICE, PROVIDENCE, R.I., MAY 1940

FISCAL YEAR 1940

FILE NO. CT-2-1291

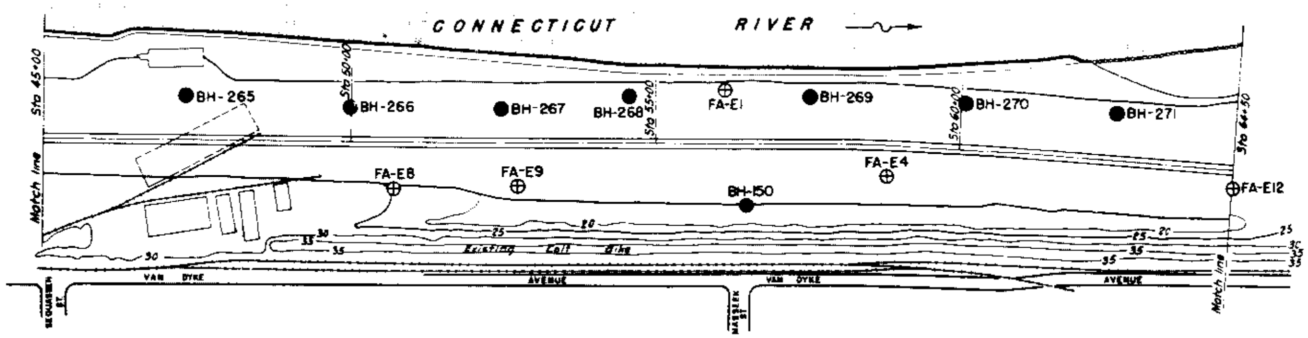
A of D

Ht. 5 & 7b

PLATE NO. 23

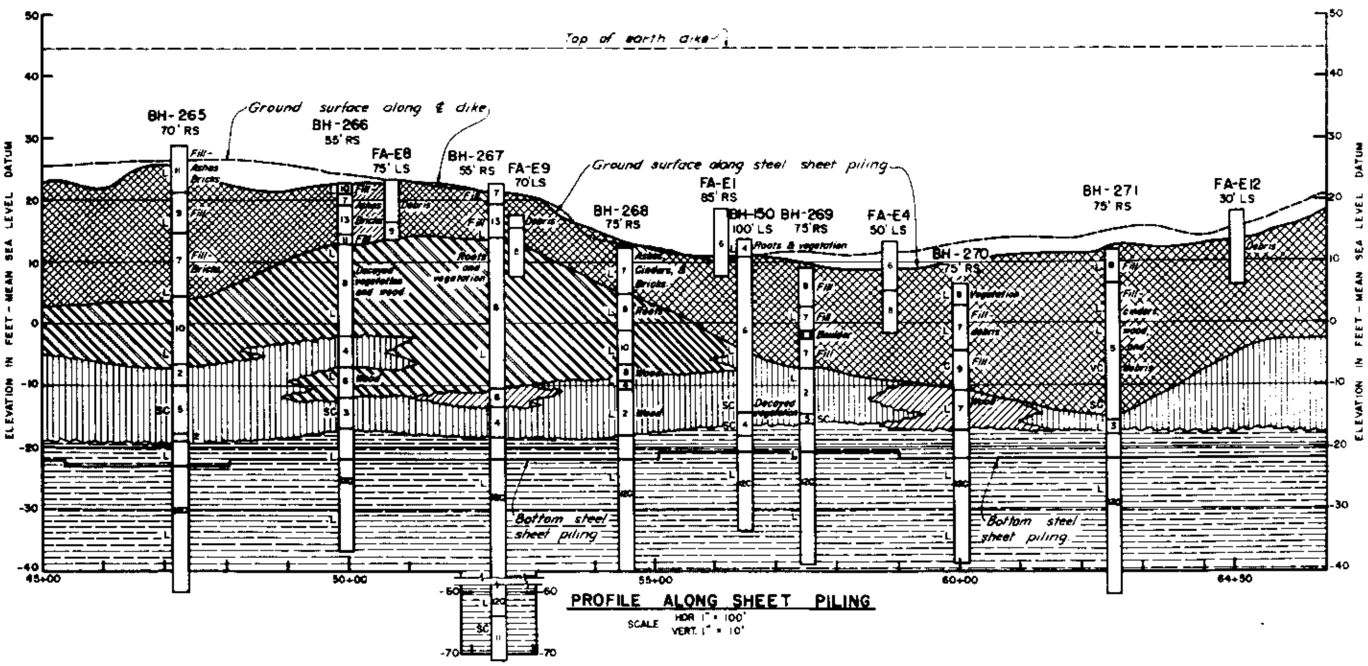
WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



PLAN

SCALE: 1" = 100'



PROFILE ALONG SHEET PILING

SCALE: HOR. 1" = 100'; VERT. 1" = 10'

DESCRIPTION OF SOIL CLASSES

1 Graded from Gravel to Coarse Sand - Contains little medium sand

2 Coarse to Medium Sand - Contains little gravel and fine sand.

3 Graded from Gravel to Medium Sand - Contains little fine sand.

4 Medium to Fine Sand - Contains little coarse sand and coarse silt

5 Graded from Gravel to Fine Sand - Contains little coarse silt.

6 Fine Sand to Coarse Silt - Contains little medium sand and medium silt.

7 Graded from Gravel to Coarse Silt - Contains little medium silt

8 Coarse to Medium Silt - Contains little fine sand and fine silt.

9 Graded from Gravel to Medium Silt - Contains little fine silt

10 Medium to Fine Silt - Contains little coarse silt and coarse clay. Possesses behavior characteristics of silt

10C Medium Silt to Coarse Clay - Contains little coarse silt and medium clay. Possesses behavior characteristics of clay.

11 Graded from Gravel or Coarse Sand to Fine Silt - Contains little coarse clay.

12 Fine Silt to Clay - Contains little medium silt and fine clay (colloids). Possesses behavior characteristics of silt.

12C Clay - Contains little silt. Possesses behavior characteristics of clay.

13 Graded from Coarse Sand to Clay - Contains little fine clay (colloids). Possesses behavior characteristics of silt

13C Clay - Graded from sand to fine clay (colloids). Possesses behavior characteristics of clay.

NOTES

Compactness was determined by the number of blows required to drive 2" O.D. sample spoon one foot with 300 pound hammer dropped 18".

Description of materials shown for borings made by the City of Hartford are taken from records in the possession of the Engineering Dep't., City of Hartford. These records are included as information supplementary to that obtained at borings by U.S. Engineer Dep't.

Class 12C indicated in bore hole records generally occurs in alternating bands, having thin layers of fine clay interbedded with thicker layers of coarse to fine silt.

Samples, test results and logs pertaining to the materials from explorations by the U.S. Engineer Dep't. are available for inspection by interested parties at United States Engineer Office, Providence, R.I.

Stations and offsets refer to ℄ dike

LEGEND

L — Loose material
SC — Slightly compact material
C — Compact material
VC — Very compact material
LS — Landside of ℄ dike
RS — Riverside of ℄ dike
BH — Drive sample bore hole by U.S. Engineer Dept.
FA — Foundation auger boring by U.S. Engineer Dept.
BH — Drive sample bore hole by City of Hartford.

- Badly weathered and fractured bedrock, core recovery less than 50 %
- Weathered and fractured bedrock, core recovery between 50 % and 75 %
- Relatively fresh or unweathered bedrock, core recovery greater than 75 %

Artificial fill - Cinders, ashes, & debris.
Pervious material - (Classes 2,3,4,& 5)
Moderately impervious material (Classes 6,& 7)
Impervious material (Classes 8, 9, 10)
Varved clay (Class 12c)
Compact glacial till (Classes 7, 9, & 11)

KEY	DATE	REVISION Indicated by Δ	REV BY	CK BY	AP BY

CONNECTICUT RIVER FLOOD CONTROL
HARTFORD DIKE
RIVERFRONT, MORGAN ST. TO STA 96+73
SUBSURFACE EXPLORATIONS NO. 3

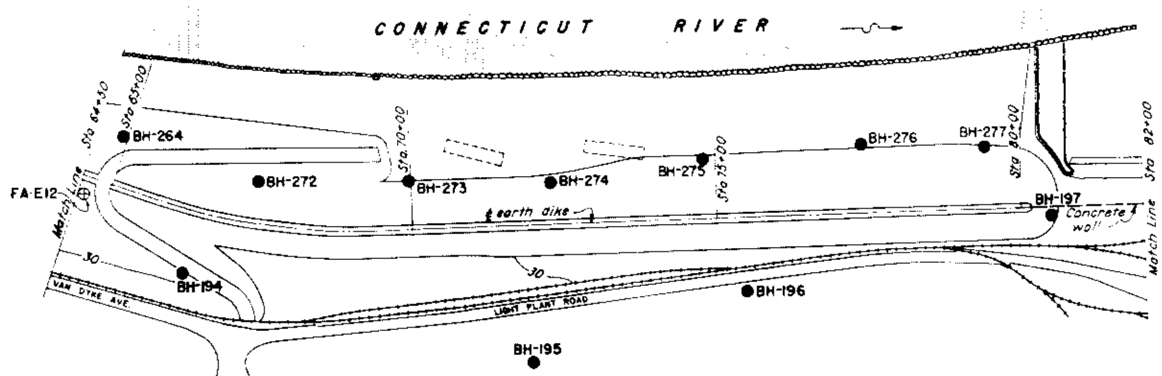
CONNECTICUT RIVER — CONNECTICUT
IN SHEETS — SCALE 1 IN = 100 FT — SHEET NO
U.S. ENGINEER OFFICE, PROVIDENCE, R.I. — MAY 1940
SUBMITTED — APPROVAL RECOMMENDED — APPROVED
SENIOR GEOLOGIST HEAD GEOLOGY SECTION — PRINCIPAL ENGINEER CHIEF, F.C. ENGINEERING DIV — LT. COL. CORPS OF ENGINEERS DISTRICT ENGINEER
COMPILED — ASST. ENGINEER
DRAWN — TRACED — CHECKED
FISCAL YEAR 1940
FILE NO. CT-2-1292

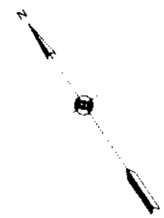
A of D — Ht 587b

PLATE NO. 24

WAR DEPARTMENT

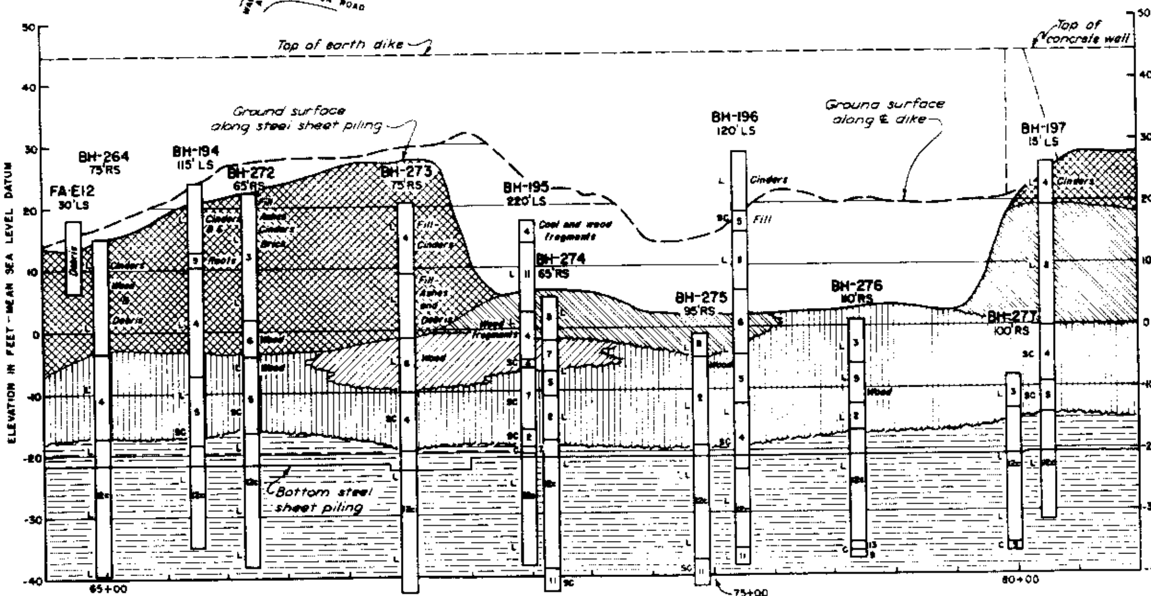
CORPS OF ENGINEERS, U. S. ARMY





PLAN

SCALE 1" = 100'



PROFILE ALONG SHEET PILING

SCALE HOR. 1" = 100' VERT. 1" = 10'

NOTE

For general notes, legend, and description of soil classes see Plate No. 24.

Stations and offsets refer to ℄ dike.

CONNECTICUT RIVER FLOOD CONTROL

HARTFORD DIKE

RIVERFRONT, MORGAN ST TO STA 96+73

SUBSURFACE EXPLORATIONS NO 4

KEY	DATE	REVISION Indicated by Δ	REV BY	CK BY	AP BY

FISCAL YEAR 1940

FILE NO. CT-2 1293

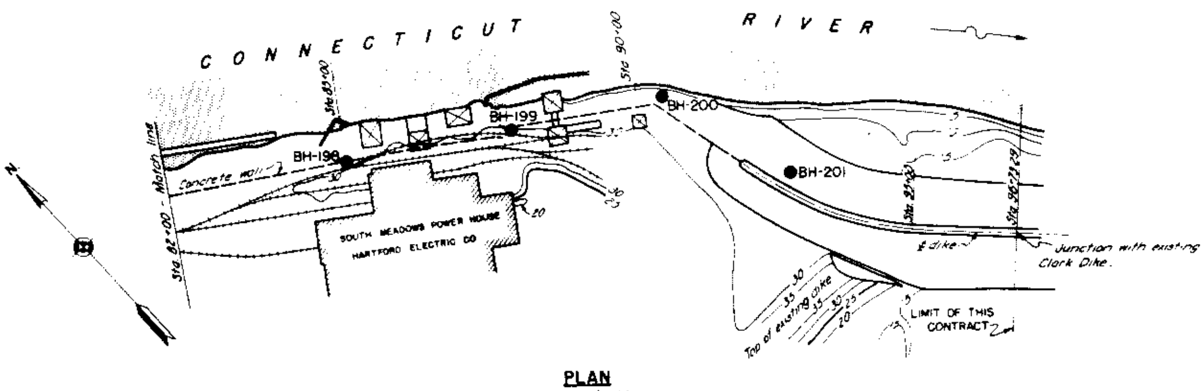
4 of D

H-5 87b

PLATE NO. 25

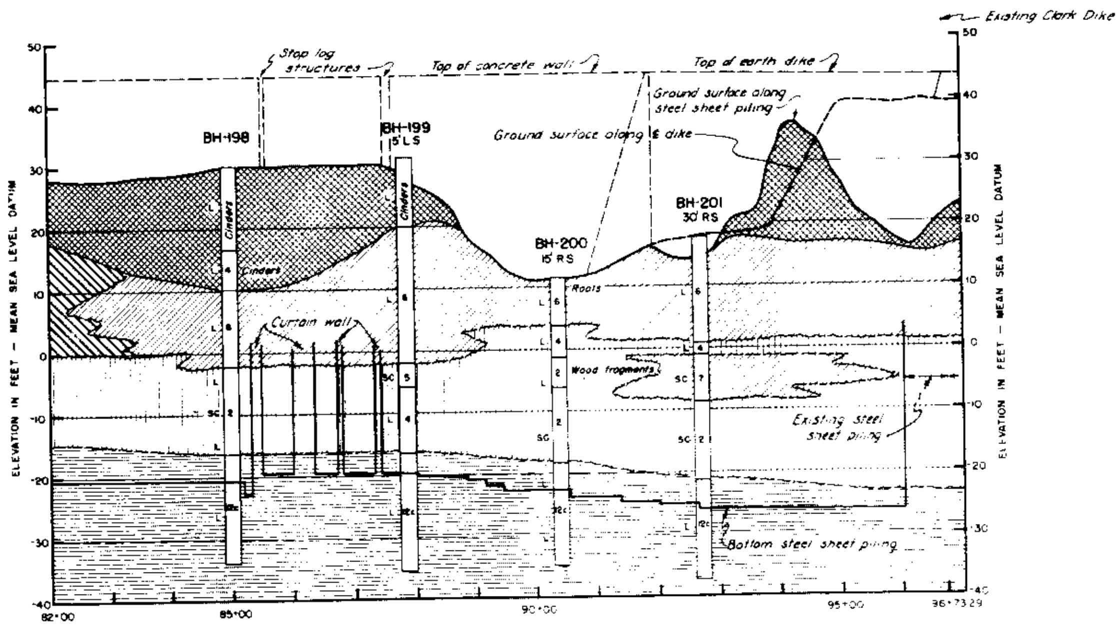
WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



PLAN

SCALE 1" = 100'



PROFILE ALONG SHEET PILING

SCALE HOR 1" = 100' VERT 1" = 10'

NOTE

For legend, general notes, and description of soil classes see Plate No. 24

Stations and offsets refer to ℄ dike

REV	DATE	REVISION	REV BY	CK BY	AP BY

CONNECTICUT RIVER FLOOD CONTROL

HARTFORD DIKE

RIVERFRONT, MORGAN ST TO STA 96+73

SUBSURFACE EXPLORATIONS NO. 5

CONNECTICUT RIVER — CONNECTICUT

IN SHEETS — SCALE 1 IN. = 100 FT — SHEET NO

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., MAY 1940

SUBMITTED — APPROVAL RECOMMENDED — APPROVED

SENIOR GEOLOGIST, HEAD GEOLOGY SECTION — PRINCIPAL ENGINEER, CHIEF ENGINEERING DIV — LT. COL. CORPS OF ENGINEERS, DISTRICT ENGINEER

COMPILED — ASST. ENGINEER — DRAWN — TRACED — CHECKED

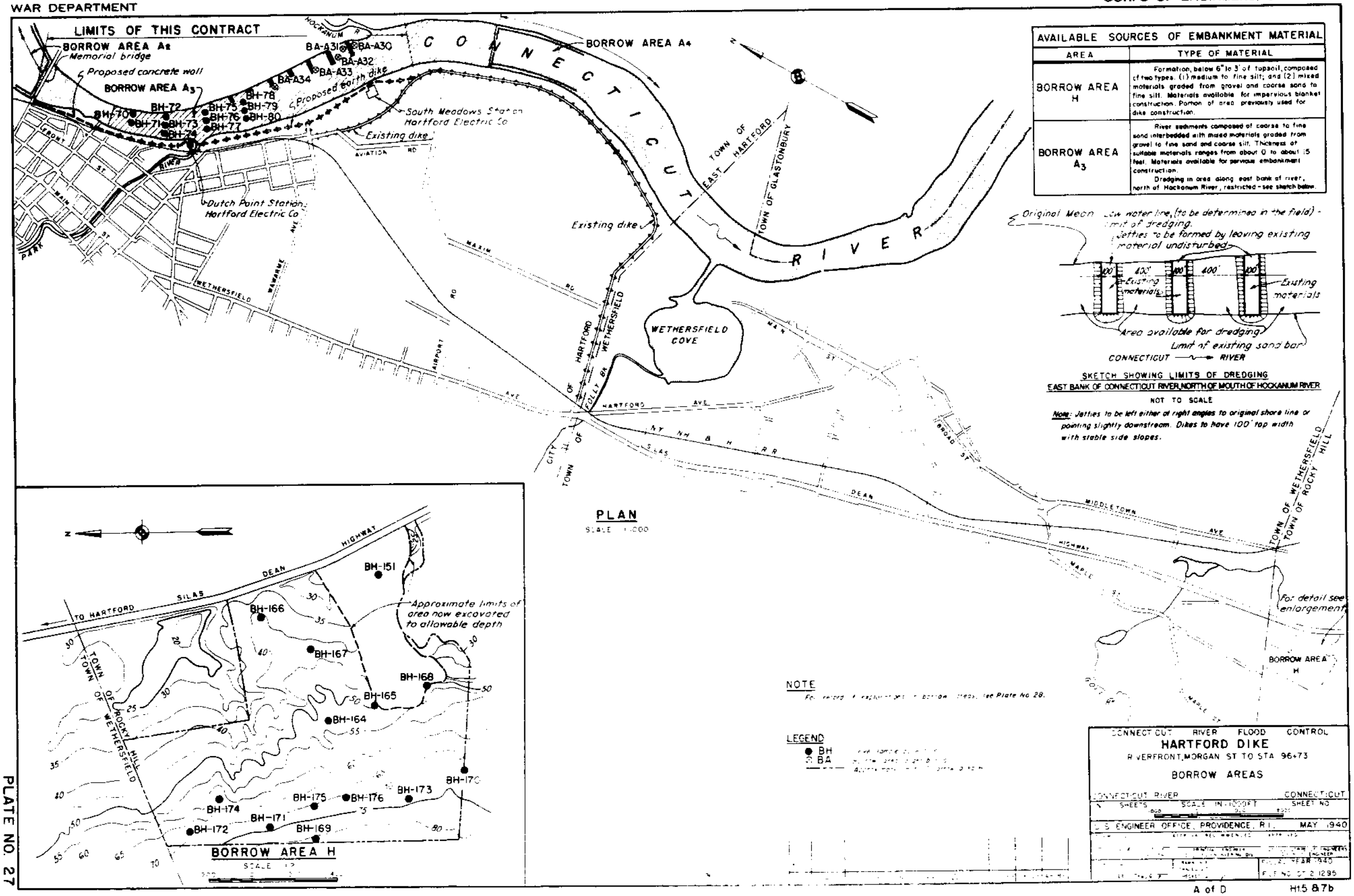
FISCAL YEAR 1940

FILE NO. CT-2-294

A of D

Ht. 5 B 7b

PLATE NO. 26



AVAILABLE SOURCES OF EMBANKMENT MATERIAL	
AREA	TYPE OF MATERIAL
BORROW AREA H	Formation, below 6" to 3' of topsoil, composed of two types. (1) medium to fine silt; and (2) mixed materials graded from gravel and coarse sand to fine silt. Materials available for impervious blanket construction. Portion of area previously used for dike construction.
BORROW AREA A_3	River sediments composed of coarse to fine sand interbedded with mixed materials graded from gravel to fine sand and coarse silt. Thickness of suitable materials ranges from about 0 to about 15 feet. Materials available for pervious embankment construction. Dredging in area along east bank of river, north of Hockanum River, restricted - see sketch below.

CONNECTICUT RIVER FLOOD CONTROL

HARTFORD DIKE

RIVERFRONT, MORGAN ST TO STA 96+73

BORROW AREAS

CONNECTICUT RIVER — CONNECTICUT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I. — MAY 1940

FILE NO CT 2 1295

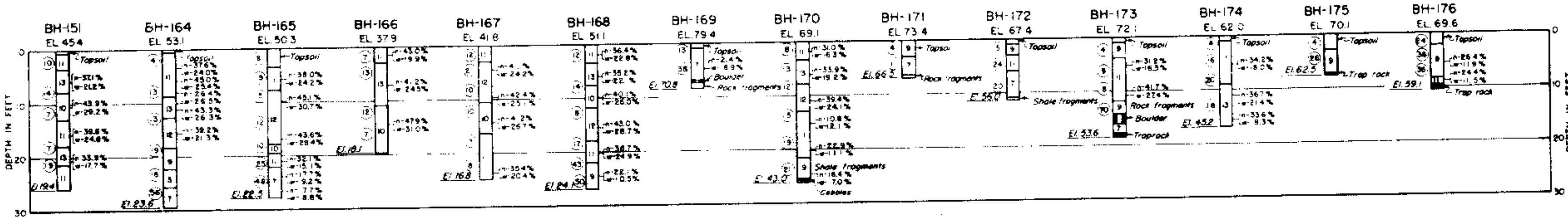
PLATE NO. 27

A of D

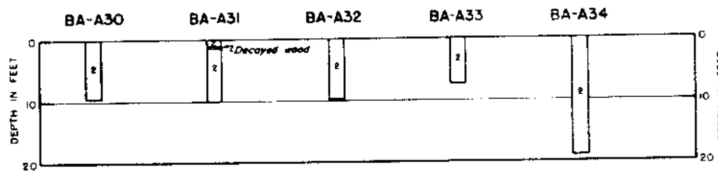
H15 87b

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



RECORD OF BORE HOLES IN BORROW AREA H



RECORD OF AUGER BORINGS IN BORROW AREA A_4

NOTES

For general notes, legend, and description of soil classes see Plate No. 24.

For locations of explorations see Plate No. 27.

Shaded areas show limits of suitable borrow.

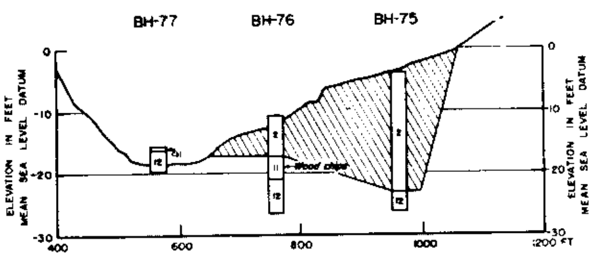
Elevations refer to Mean Sea Level Datum.

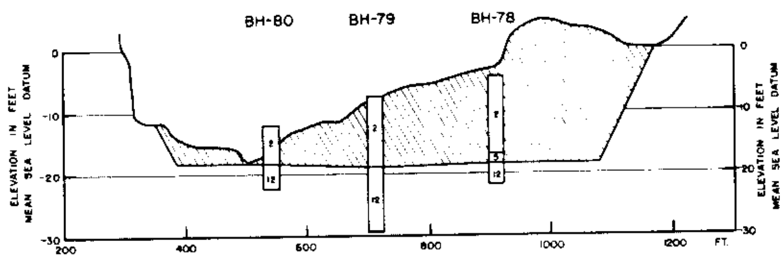
Additional borings are being drilled in the Connecticut River at the present time. The records of these holes will be made available as they are completed.

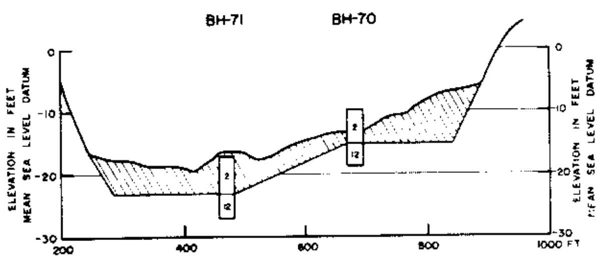
"n" indicates porosity in natural state $= \frac{\text{Volume of voids}}{\text{Total volume}}$

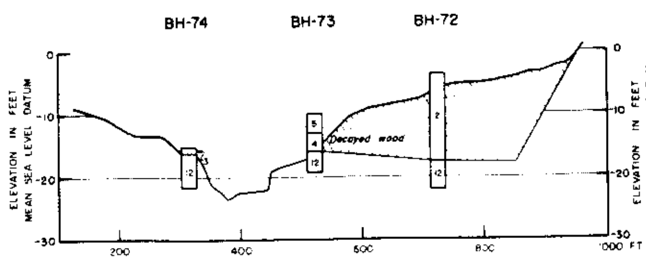
"w" indicates water content in natural state $= \frac{\text{Weight of water}}{\text{Weight of solids}}$

Numbers in circles indicate blows required to drive 2" O.D. sample spoon 1 foot with 300 lb. hammer dropped 18".









CROSS-SECTIONS IN RIVER-LOOKING UPSTREAM

KEY	DATE	REVISION indicated by Δ	REV BY	CK BY	AP BY

CONNECTICUT RIVER FLOOD CONTROL

HARTFORD DIKE

RIVERFRONT, MORGAN ST TO STA 96+73

RECORD OF BORROW EXPLORATIONS

CONNECTICUT RIVER — CONNECTICUT

IN SHEETS — SCALES AS SHOWN — SHEET NO

U S ENGINEER OFFICE, PROVIDENCE, R.I., MAY 1940

SUBMITTED — APPROVAL RECOMMENDED — APPROVED

SENIOR GEOLOGIST HEAD, GEOLOGY SECTION — PRINCIPAL ENGINEER CHIEF, F.C. ENGINEERING DIV — LT. COL. CORPS OF ENGINEERS DISTRICT ENGINEER

COMPILED — ASST. ENGINEER

DRAWN — TRACED — CHECKED

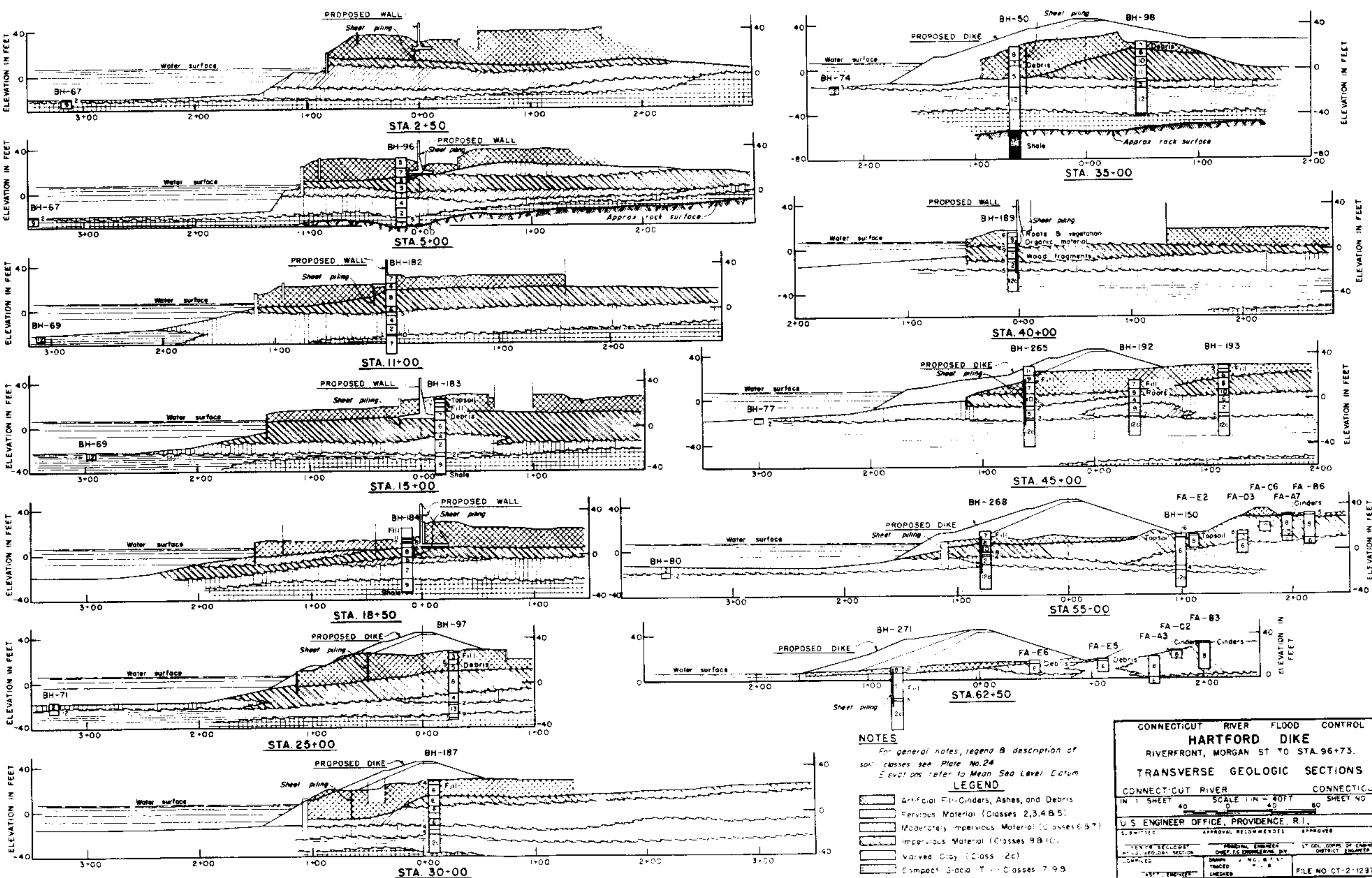
FISCAL YEAR 1940

FILE NO CT-2-1296

A of D

Ht.5 & 7b

PLATE NO. 28



NOTES

For general notes, legend & description of soil classes see Plate No. 24

Elevations refer to Mean Sea Level Datum

LEGEND

- Artificial Fill-Cinders, Ashes, and Debris
- Pervious Material (Classes 2,3,4 & 5)
- Moderately Impervious Material (Classes 6 & 7)
- Impervious Material (Classes 9 & 10)
- Varved Clay (Class 12c)
- Compact Glacial Till (Classes 7, 9, 8)

CONNECTICUT RIVER FLOOD CONTROL

HARTFORD DIKE

RIVERFRONT, MORGAN ST TO STA. 96+73.

TRANSVERSE GEOLOGIC SECTIONS

CONNECTICUT RIVER — CONNECTICUT

IN 1 SHEET — SCALE 1 IN = 40 FT — SHEET NO. 1

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

SUBMITTED — APPROVAL RECOMMENDED — APPROVED

SENIOR GEOLOGIST, HEAD, GEOLOGY SECTION — PRINCIPAL ENGINEER, CHIEF, E.C. ENGINEERING DIV. — LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

COMPILED — ASST. ENGINEER — DRAWN — TRACED — CHECKED

FILE NO. CT-2-1297

Analysis of Design. Ht. 5 & 7b

PROVIDENCE DISTRICT SOIL CLASSIFICATION

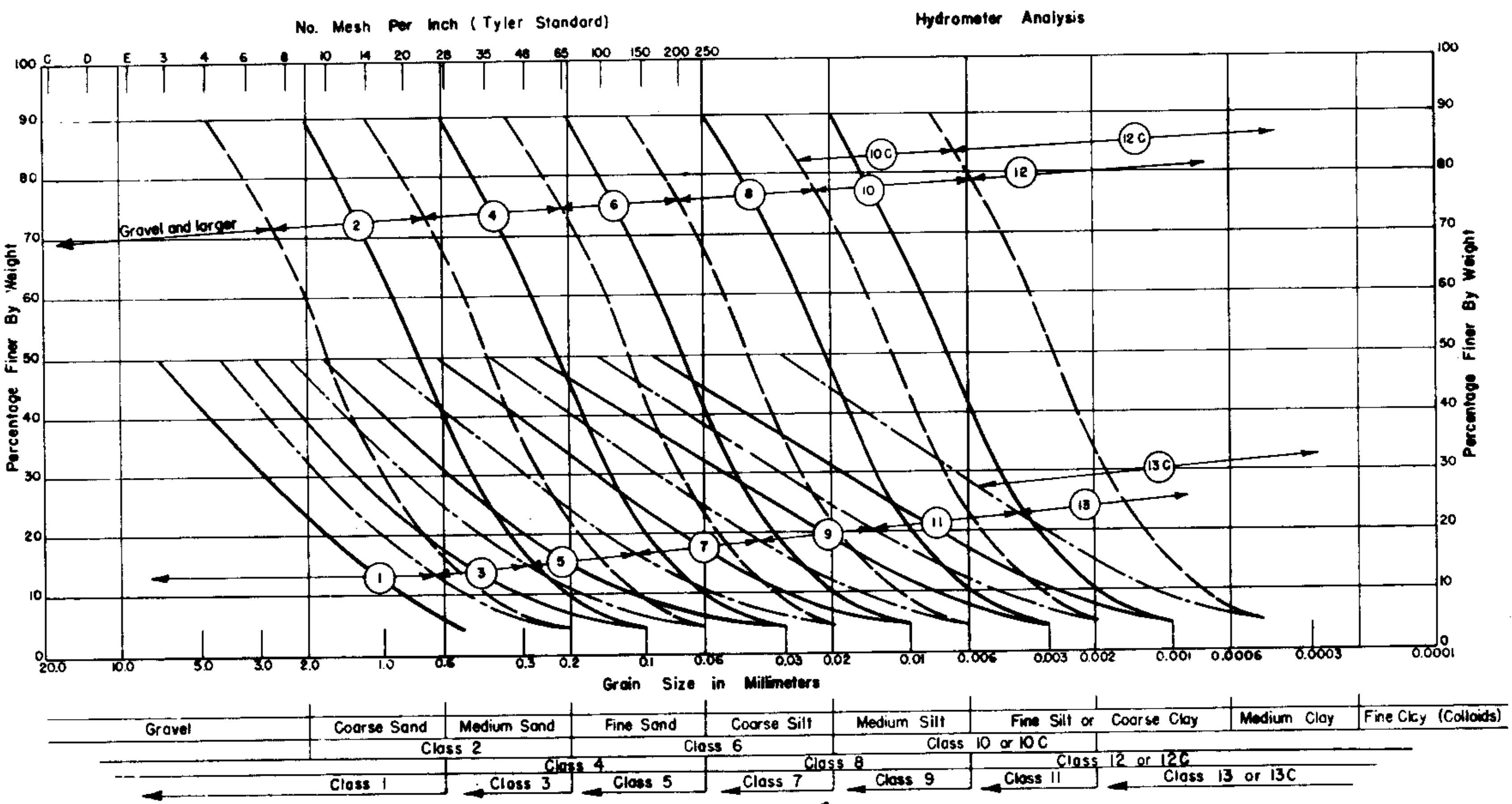
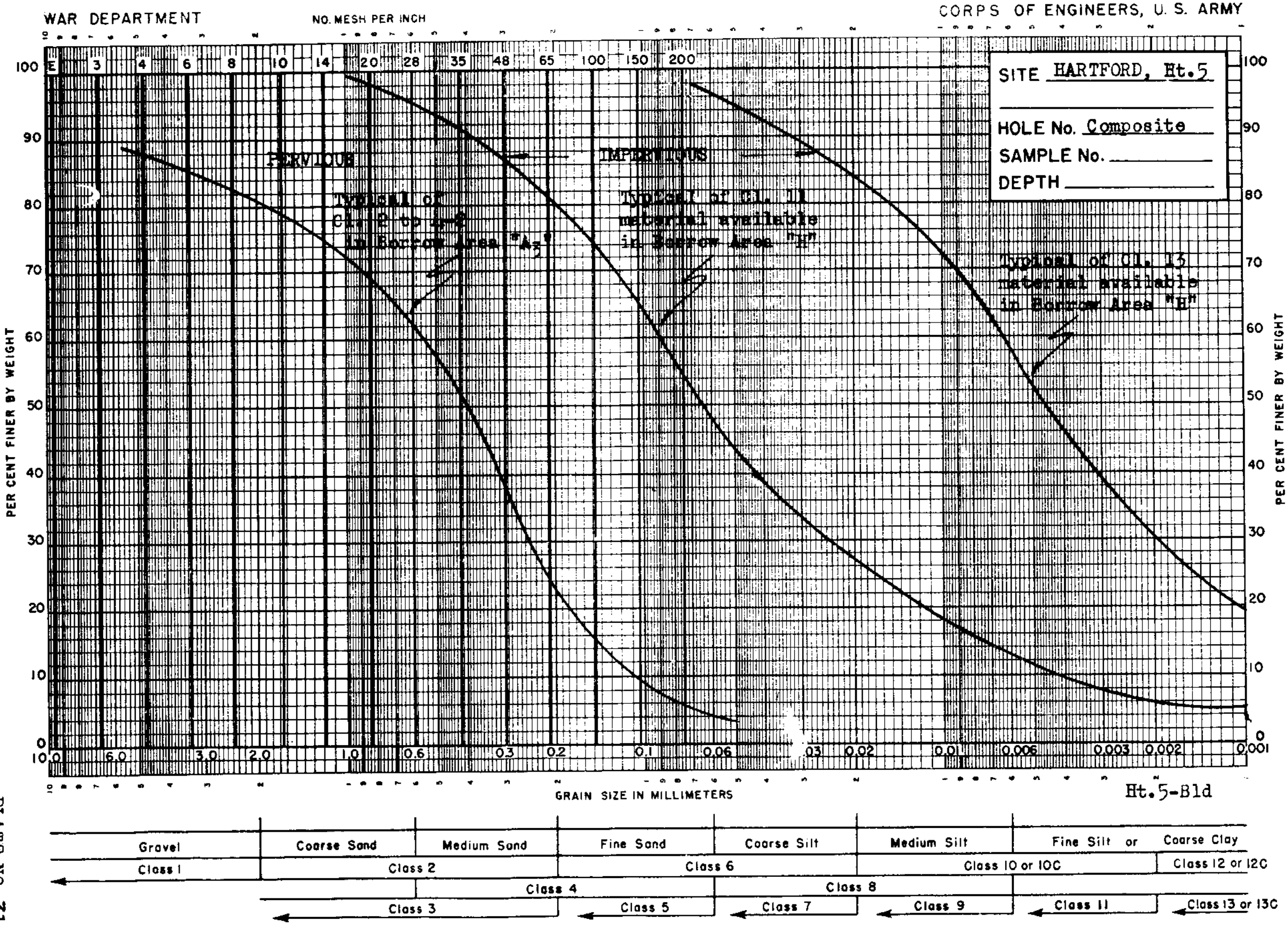


DIAGRAM SHOWING LIMITS OF SOIL CLASSES

PLATE NO.30

WAR DEPARTMENT | CORPS OF ENGINEERS, U. S. ARMY



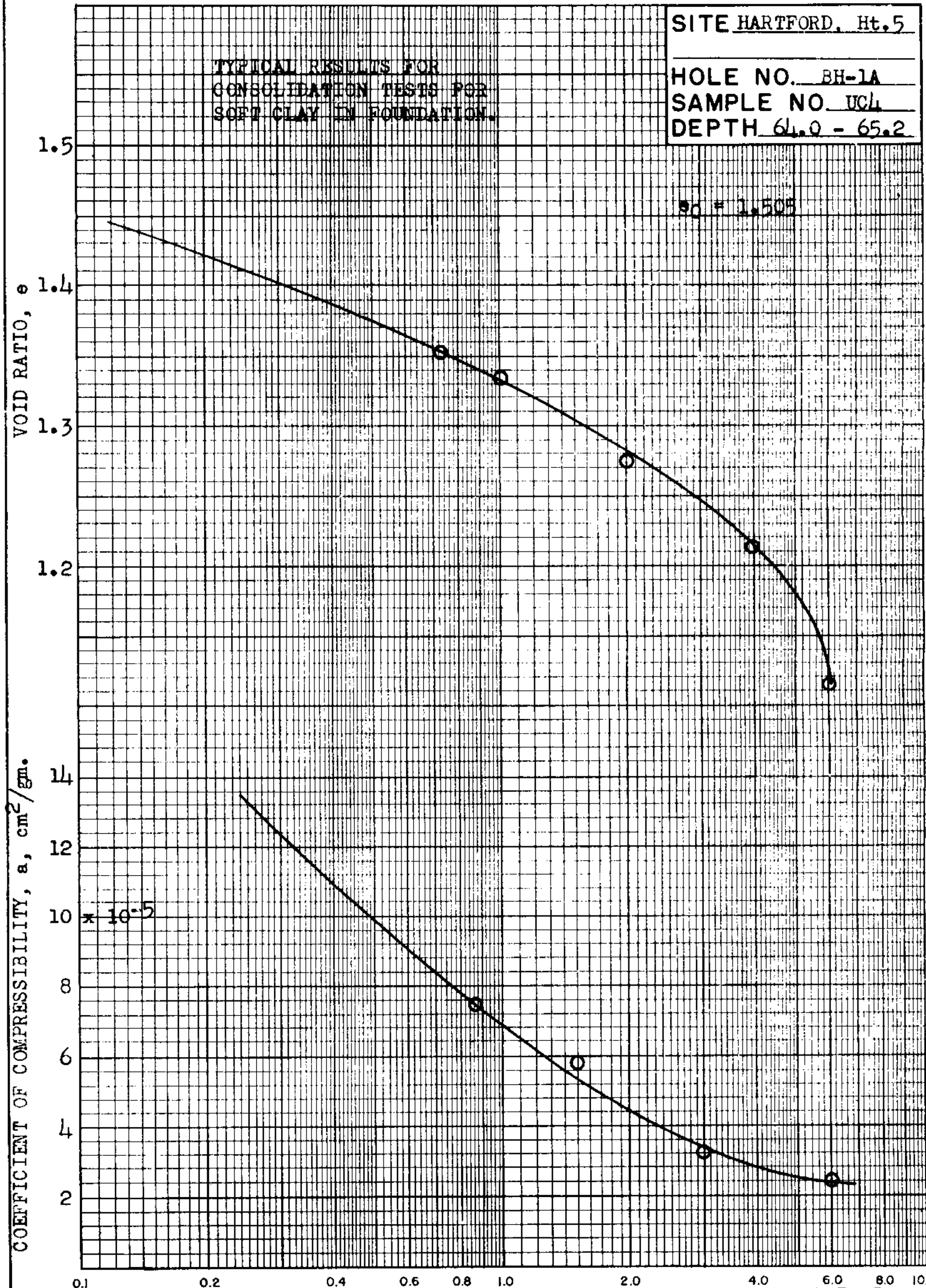
SOILS LABORATORY | MECHANICAL ANALYSIS | PROVIDENCE, R.I.

PLATE NO. 31

CONSOLIDATION CHARACTERISTICS

SITE HARTFORD, Ht.5

HOLE NO. BH-1A
SAMPLE NO. UC4
DEPTH 64.0 - 65.2



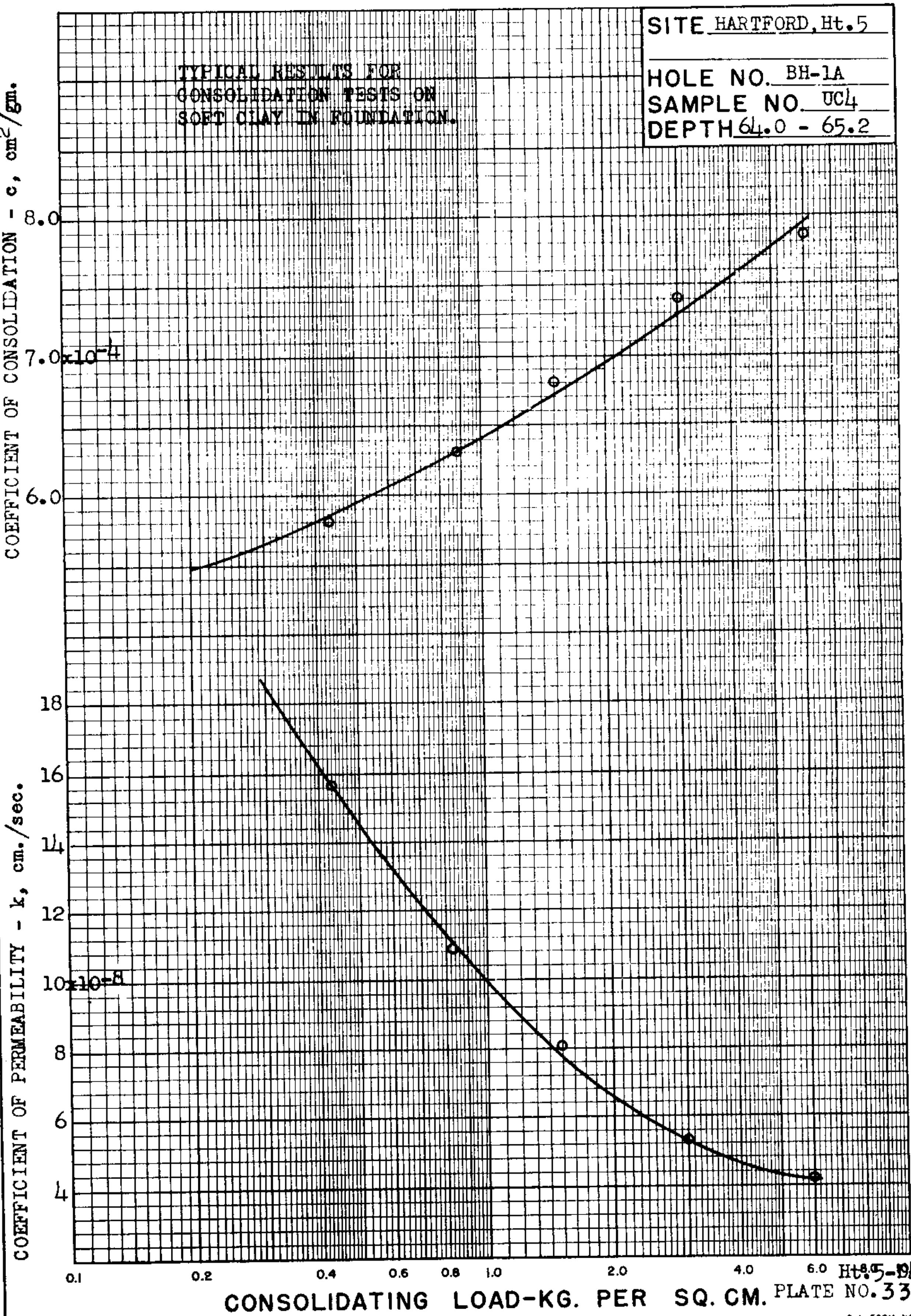
CONSOLIDATING LOAD-KG. PER SQ. CM.

Ht.5-D3d
PLATE NO. 32

S. L. FORM NO. 71

CONSOLIDATION CHARACTERISTICS

SITE HARTFORD, Ht.5
HOLE NO. BH-1A
SAMPLE NO. UC4
DEPTH 64.0 - 65.2



Ht.5-D.d
PLATE NO. 33

S. L. FORM NO. 71

SHEAR TEST

SUPPLEMENTARY DATA

Rate of strain 0.06+ in./min.

Consolidation Full

Shear Plane Dry

Remarks None

Class 13-11

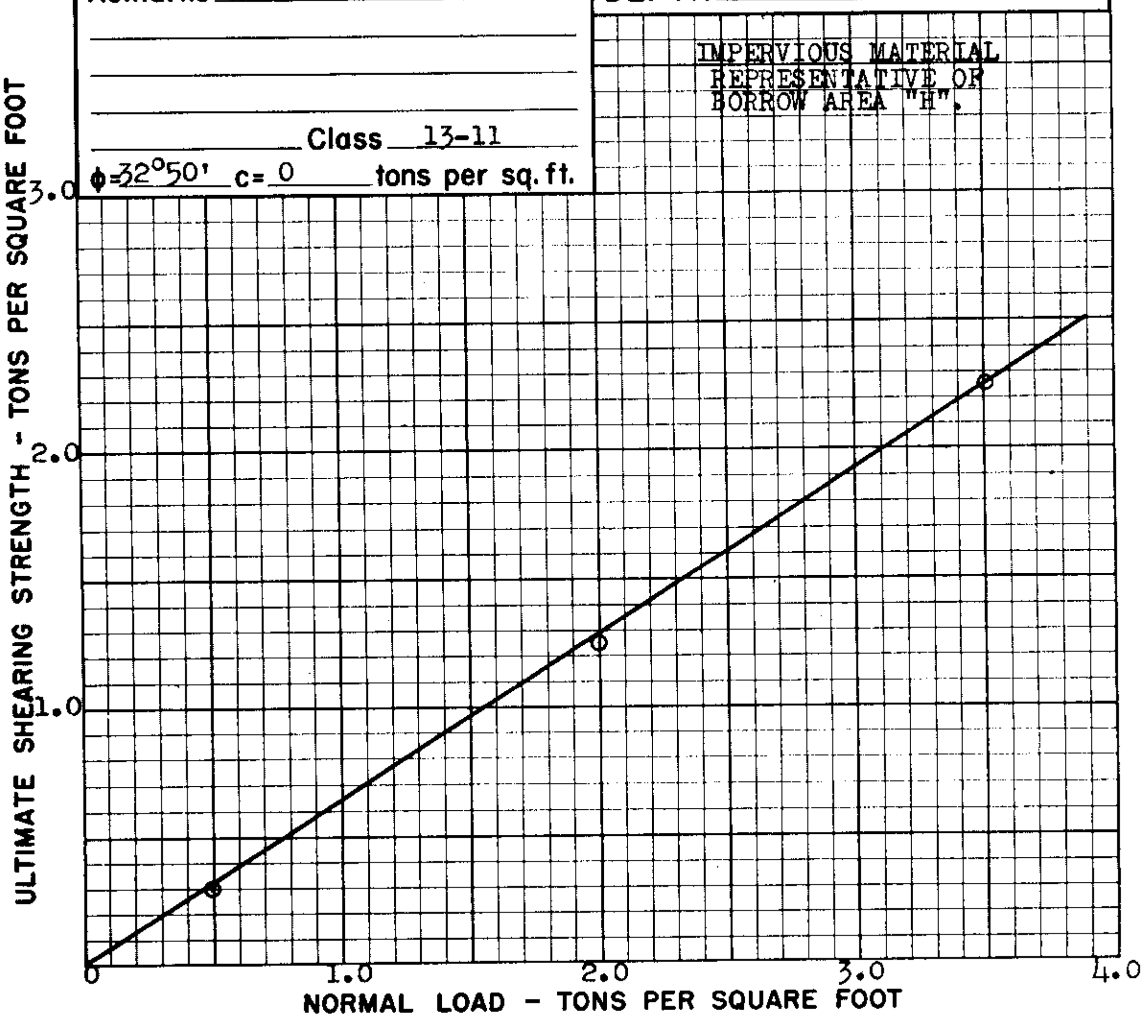
ϕ=32°50' c= 0 tons per sq. ft.

SITE HARTFORD, Ht.5

HOLE NO. BA-105

SAMPLE NO. B2

DEPTH 3.6'



Ht.5-D1d

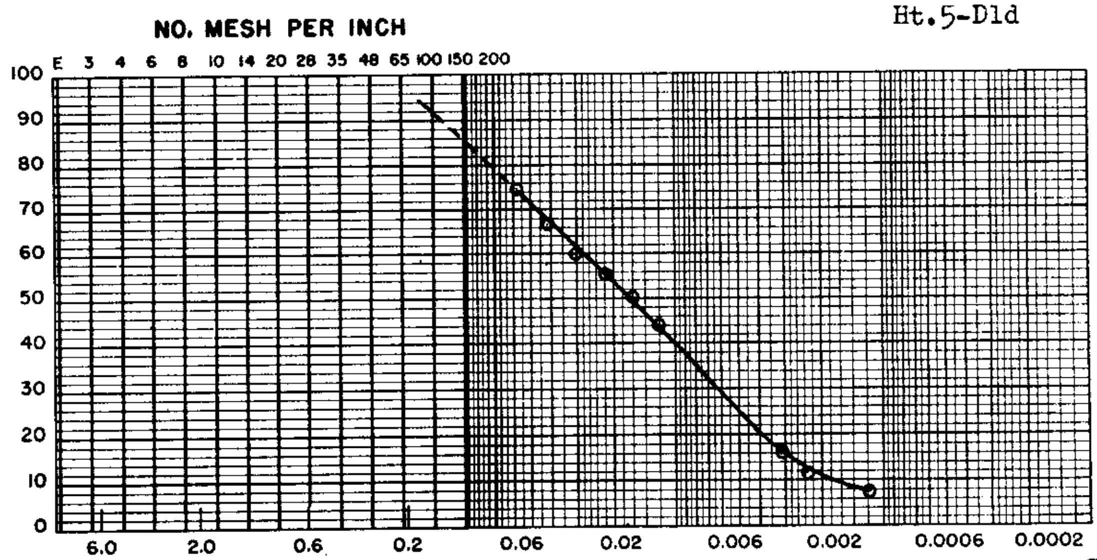
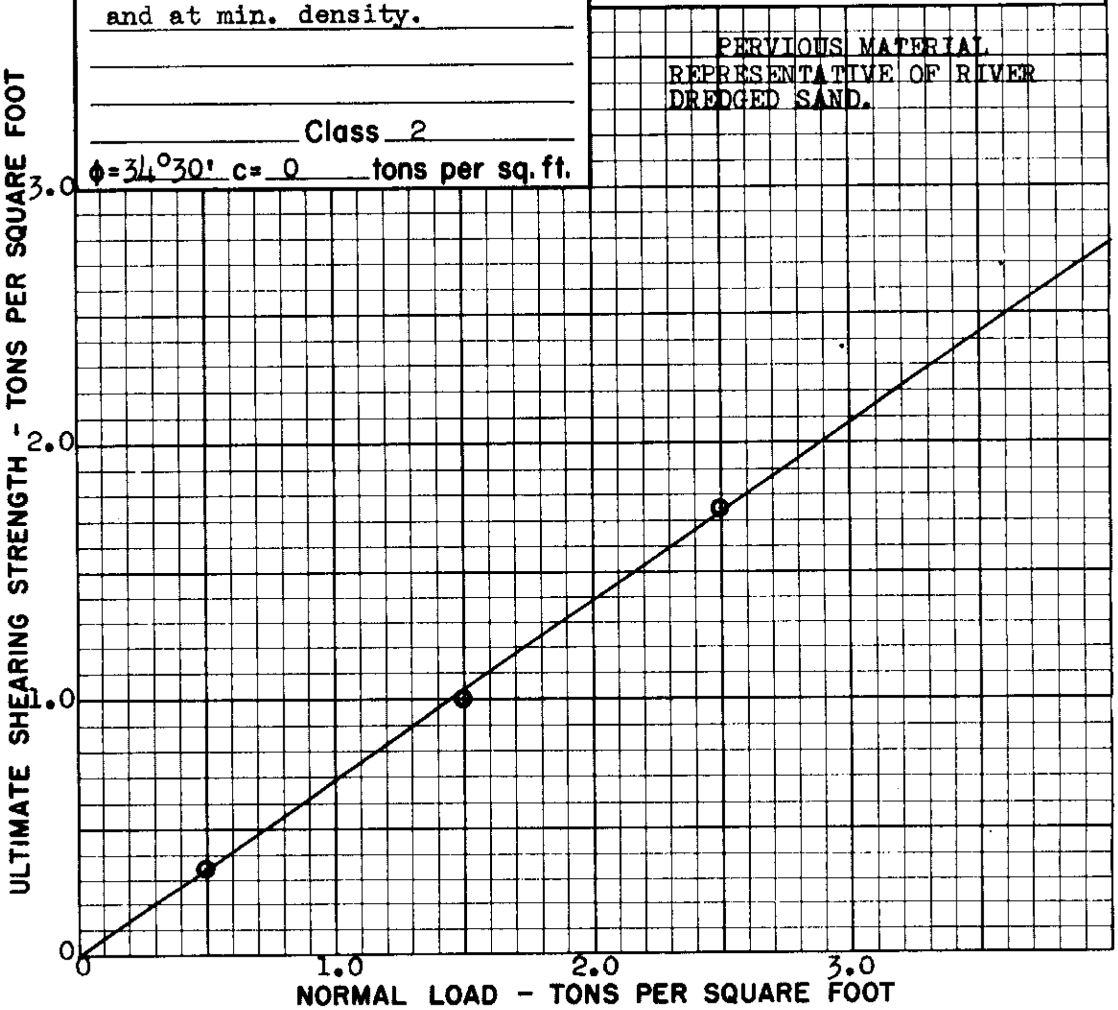


PLATE NO. 34

S.L. FORM NO. 66

SHEAR TEST

SUPPLEMENTARY DATA	
Rate of strain 0.06± in./min.	SITE HARTFORD Ht.5
Consolidation Full	HOLE NO. Composite of BH-57, 58, 59 and 60.
Shear Plane Dry	SAMPLE NO. LB8
Remarks Sample placed dry and at min. density.	DEPTH
Class 2	
ϕ=34°30' c= 0 tons per sq. ft.	



Ht.5-D2d

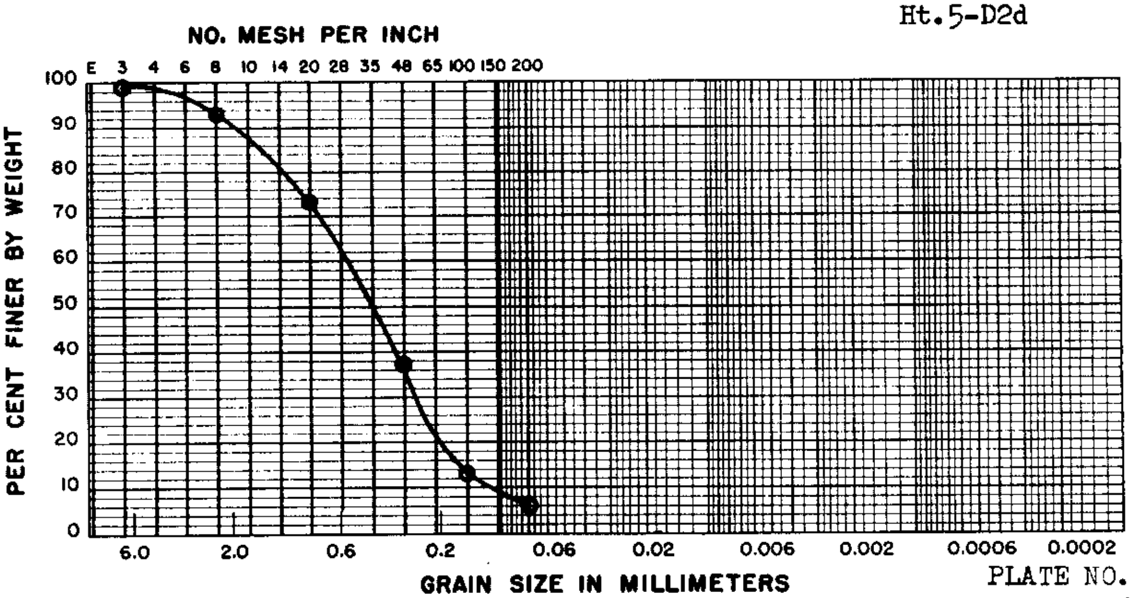


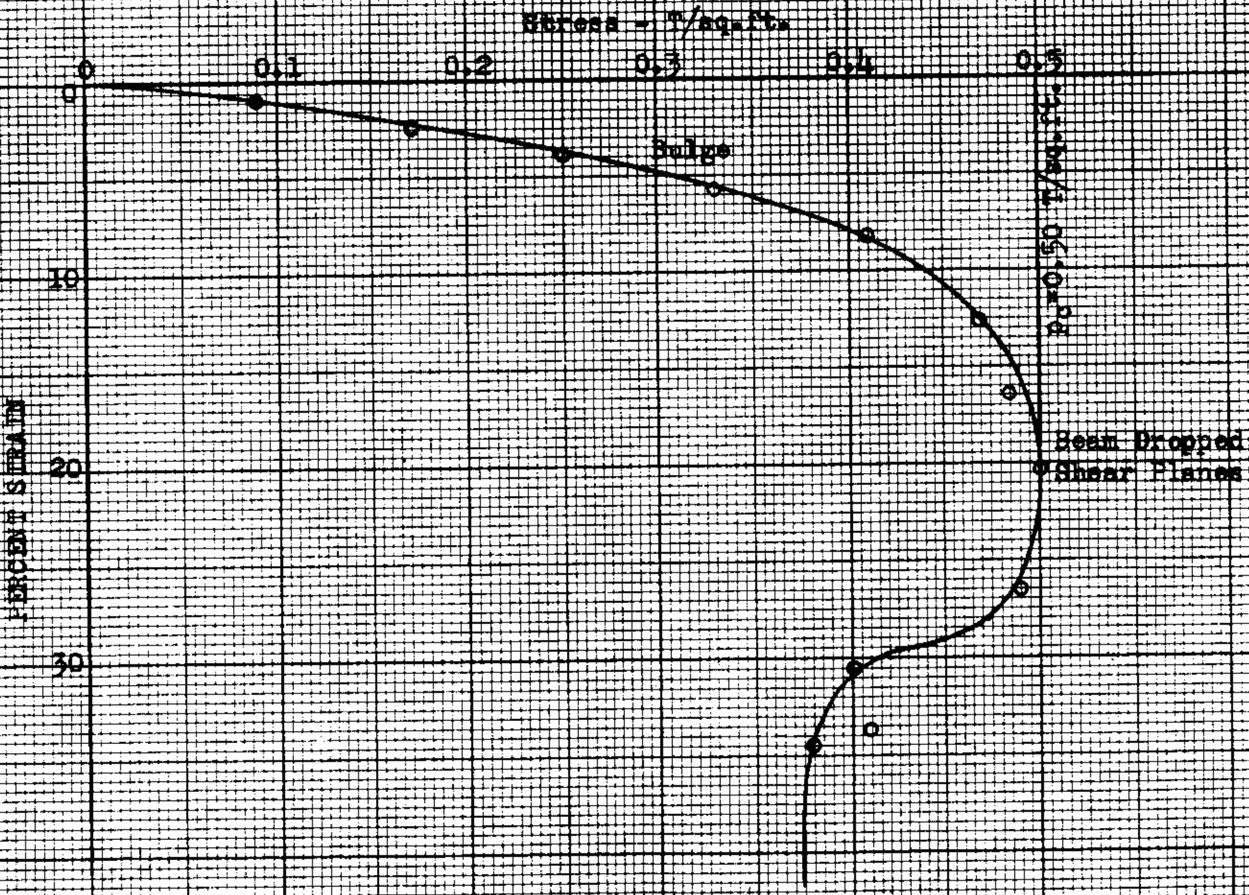
PLATE NO. 35

S.L. FORM NO. 66

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY

SITE: HARTFORD, Ht.5
HOLE NO: BH-1A
SAMPLE NO: UC4
DEPTH: 57.5 - 59.0



UNCONFINED COMPRESSION TEST

Typical results for soft clay in foundation.

p_c = 0.50 T/sq.ft.

$c = \frac{p_c}{2}$ = 0.25 T/sq.ft.

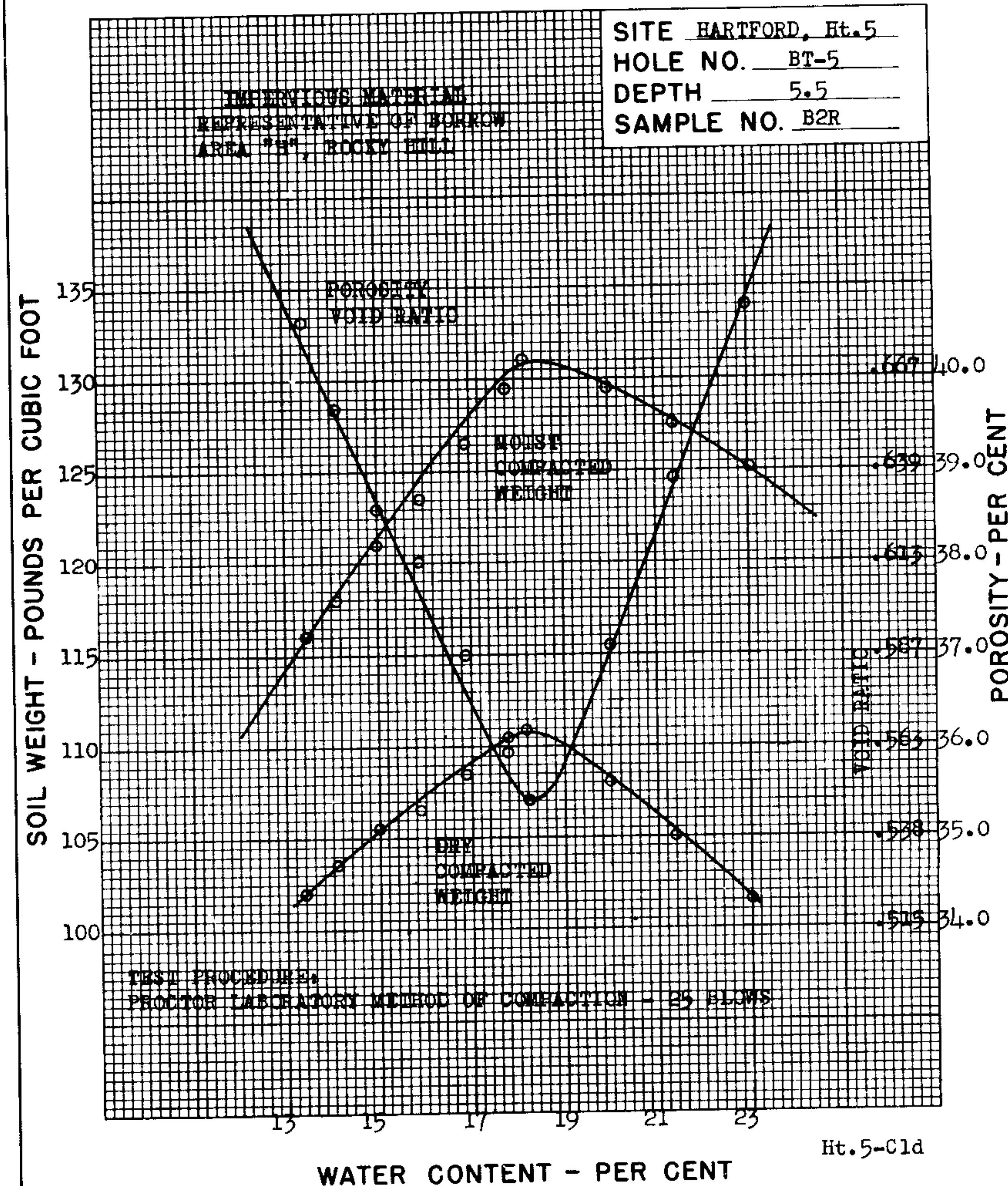
w = 49.2%

Time = 10-1/2 min.

WAR DEPARTMENT CORPS OF ENGINEERS, U. S. ARMY

COMPACTION CHARACTERISTICS

SITE HARTFORD, Ht.5
HOLE NO. BT-5
DEPTH 5.5
SAMPLE NO. B2R



Ht.5-Cld

Class 13

No. Blows/Layer 25
Area of Tamper, sq. in. 3.14
Weight of Tamper, lbs. 5.5
Fall of Tamper, in. 12

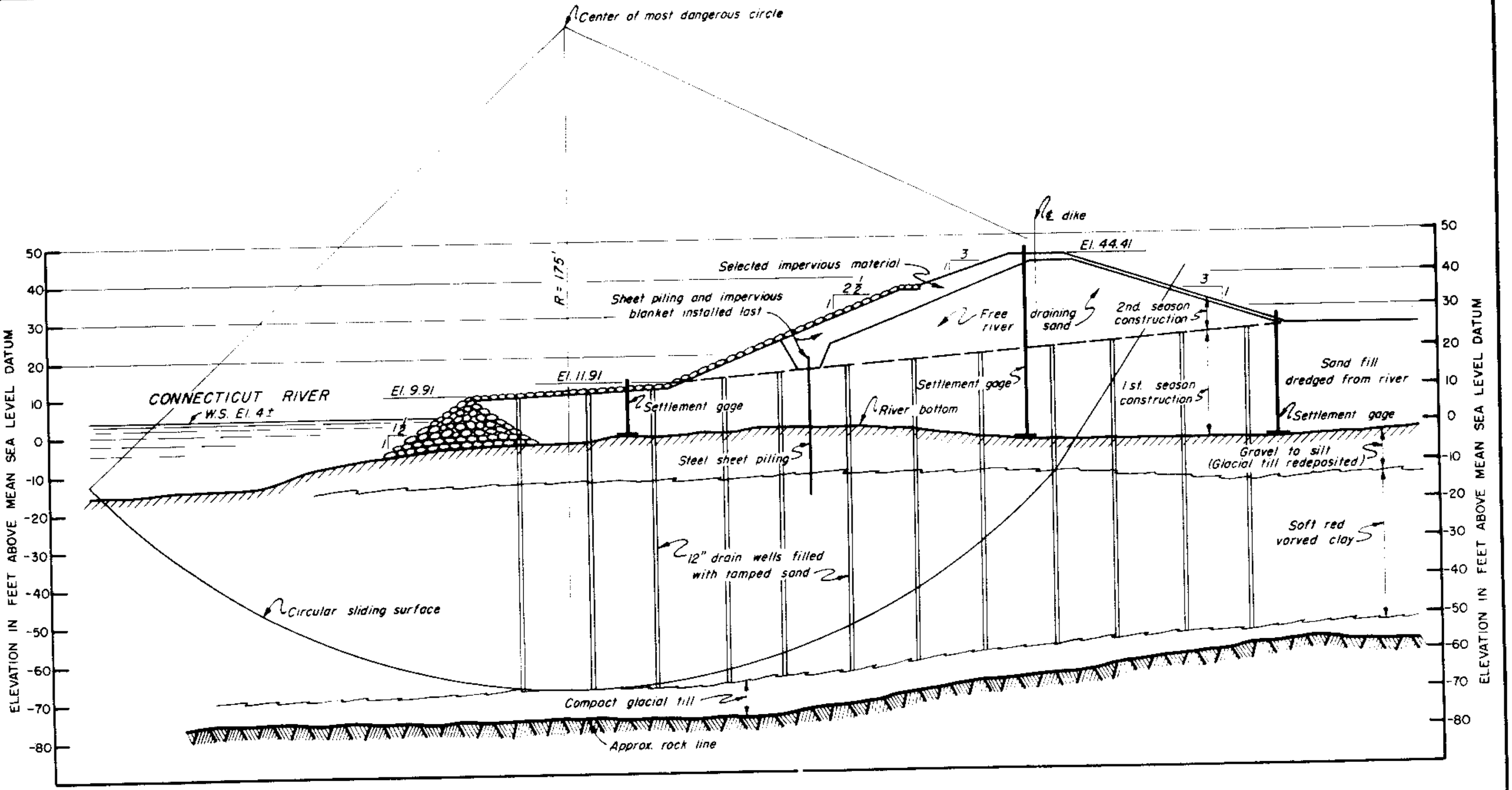
MATERIAL SCREENED OUT

Minimum Size, mm. ——
Per Cent by weight ——

e at w(opt) = 0.55

PLATE NO. 37

SOILS LABORATORY PROVIDENCE, R. I.



SECTION AT STA. 43+00±

NOTE

Factor of safety against sliding-

0.70 - No wells, 1st season construction.

1.15 - With wells, 2nd season construction.

CONNECTICUT RIVER FLOOD CONTROL

HARTFORD DIKE

FOUNDATION TREATMENT BY DRAIN WELLS

CONNECTICUT RIVER CONNECTICUT

SCALE 1" = 20'

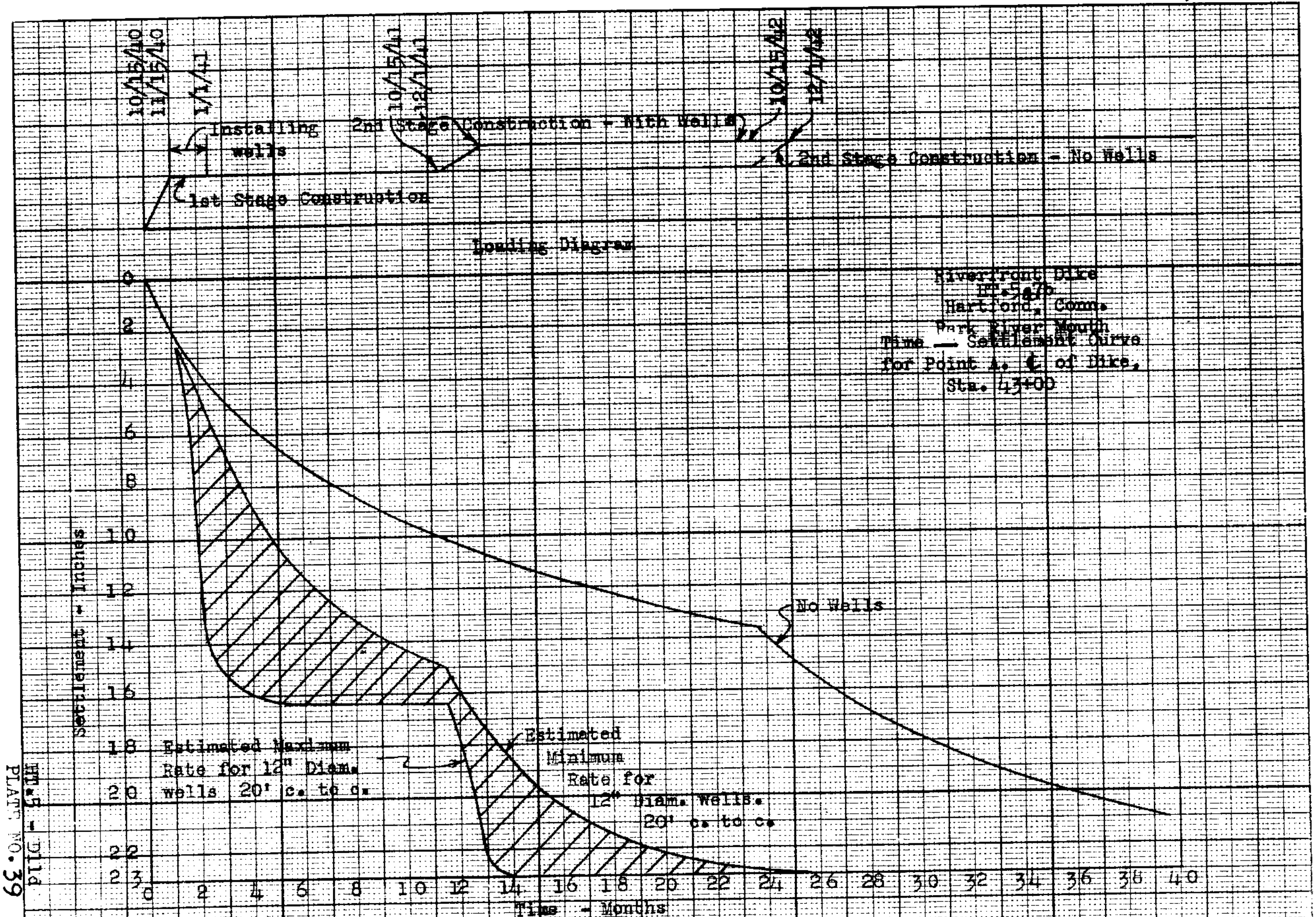
20 0 20 40'

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., MAY 13, 1940

SUBMITTED BY ANALYSIS BY DRAWN BY

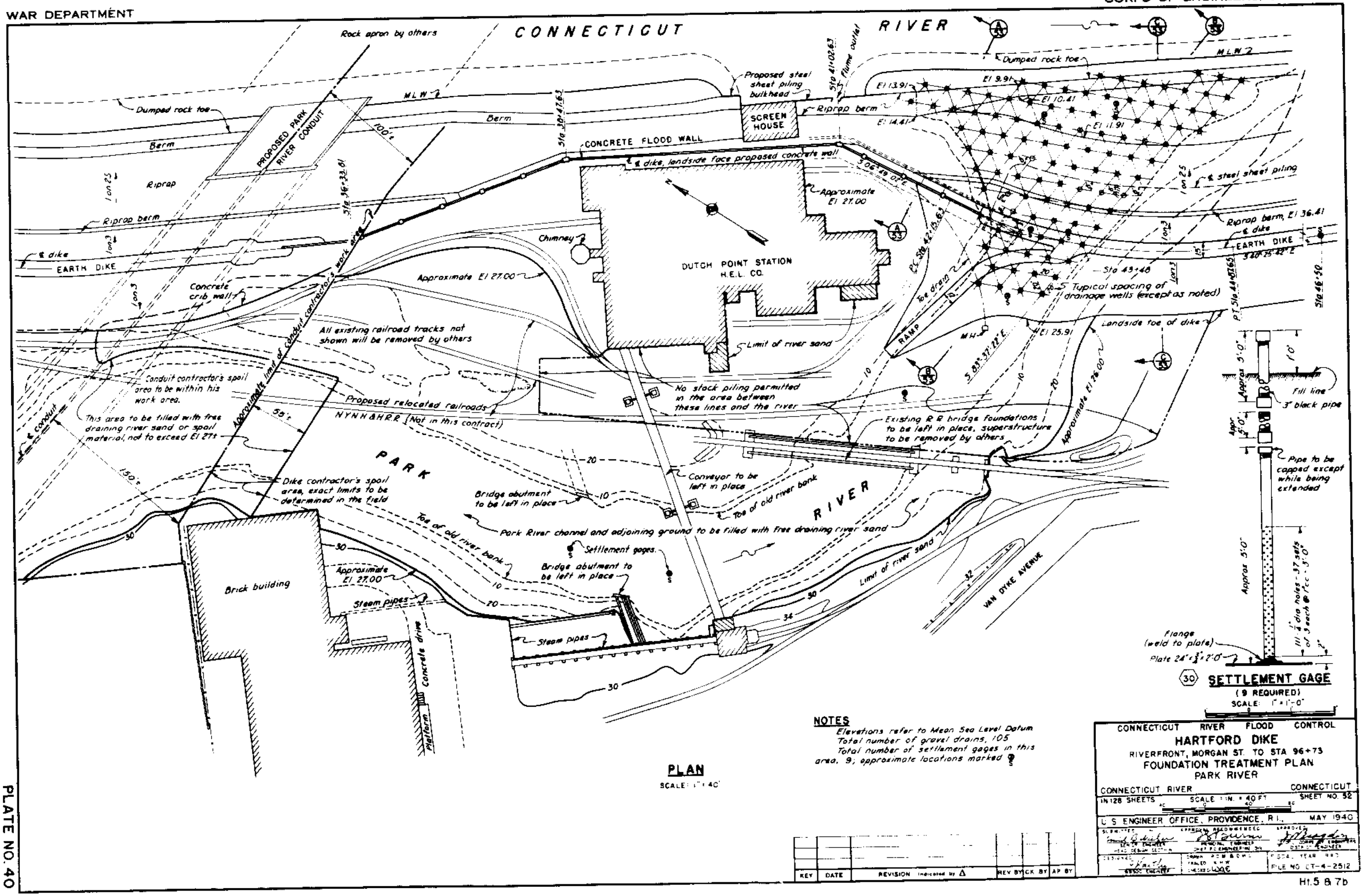
S.L. NO. H1.5-A8d

PLATE NO. 38


10/15/40
11/15/40
1/1/41
10/15/41
12/1/41
10/15/42
12/1/42
Installing wells
2nd Stage Construction - With Wells
2nd Stage Construction - No Wells
1st Stage Construction
Loading Diagram
Riverfront Dike
HT.5.7b
Hartford, Conn.
Park River Mouth
Time — Settlement Curve
for Point A. ℄ of Dike,
Sta. 43+00
No Wells
Estimated Maximum
Rate for 12" Diam.
wells 20' c. to c.
Estimated
Minimum
Rate for
12" Diam. Wells.
20' c. to c.
Settlement - Inches
0
2
4
6
8
10
12
14
16
18
20
22
23
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
Time - Months

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



NOTES

Elevations refer to Mean Sea Level Datum.
Total number of gravel drains, 105
Total number of settlement gages in this area, 9; approximate locations marked

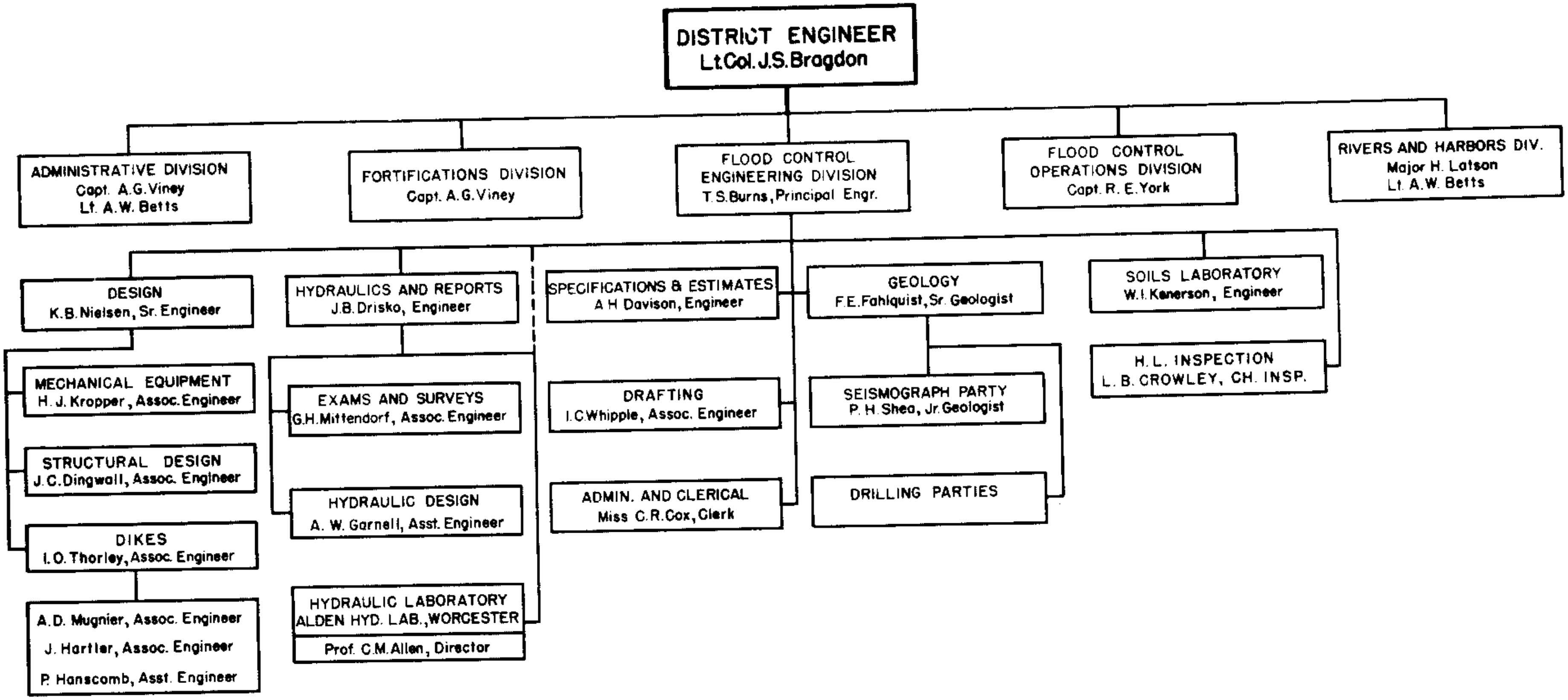
CONNECTICUT RIVER FLOOD CONTROL
HARTFORD DIKE
RIVERFRONT, MORGAN ST. TO STA 96+73
FOUNDATION TREATMENT PLAN
PARK RIVER

CONNECTICUT RIVER — CONNECTICUT
IN 128 SHEETS — SCALE 1 IN. = 40 FT — SHEET NO. 52
U. S. ENGINEER OFFICE, PROVIDENCE, R.I. — MAY 1940
FILE NO. CT-4-2512

KEY	DATE	REVISION Indicated by Δ	REV BY	CK BY	AP BY

Ht.5 & 7b

PLATE NO. 40



ORGANIZATION CHART

FLOOD CONTROL

ENGINEERING DIVISION

U.S ENGINEER OFFICE, PROVIDENCE, R.I.

PLATE NO.41